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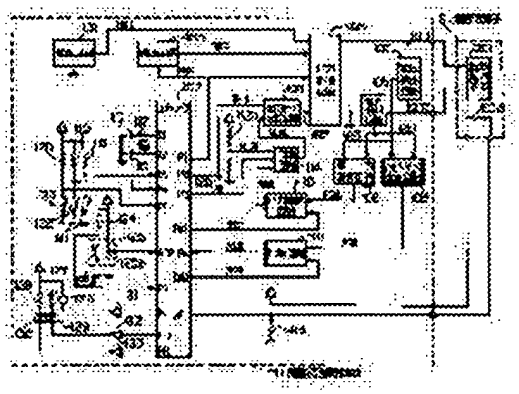
(54) ULTRASONIC TREATING DEVICE

(57)Abstract:

PURPOSE: To provide an ultrasonic treating device capable of dealing with various different ultrasonic treatment methods with plural ultrasonic conductors and one unit of ultrasonic treating device body.

CONSTITUTION: This ultrasonic treatment device has an oscillation circuit 103 which is capable of oscillating high-frequency signals of two kinds of different frequencies, the ultrasonic conductors 2, an overheat preventive function which is capable of changing over the decision criteria of the reflectivity of the radiation surface of the ultrasonic waves rising to a high level in the event of insufficiency of the contact of the ultrasonic conductors 2 with the human body and a program mode of alternately changing over the radiation method of the ultrasonic waves to continuous one and pulses.



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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The 2nd ultrasonic electrode in which the 1st ultrasonic electrode which has the 1st ultrasonic vibrator, and said 1st ultrasonic vibrator have the 2nd ultrasonic vibrator with which resonance frequency differs, Said 1st [the] and the output terminal in which said either of the 2nd ultrasonic electrode is attached, The oscillator circuit which oscillates and outputs a RF signal, and a magnification means to amplify the output of said oscillator circuit and to output to said output terminal, The ultrasonic therapy apparatus which comes to provide the frequency switch means which switches alternatively the oscillation frequency of the RF signal oscillated in said oscillator circuit to either the resonance frequency of said 1st ultrasonic vibrator, or the resonance frequency of said 2nd ultrasonic vibrator.
[Claim 2] Said 1st ultrasonic electrode has the 1st resistor, and said 2nd ultrasonic electrode has the 2nd resistor with different resistance from said 1st resistor. The resistance detector which detects the resistance of said 1st resistor or said 2nd resistor with the detection value acquired according to the resistance ratio of said 1st resistor or said 2nd resistor, and the 3rd resistor prepared beforehand, The ultrasonic therapy apparatus according to claim 1 characterized by providing a frequency setting signal output means to output the frequency setting signal which switches said frequency switch means according to the detection result of said resistance detector.
[Claim 3] The ultrasonic therapy apparatus according to claim 2 characterized by providing the 1st filter circuit which reduces the harmonic content of the output of said magnification means, the 2nd filter circuit which has different cut-off frequency from said 1st filter circuit, and reduces the harmonic content of the output of said magnification means, and a filter circuit switch means to choose either said 1st filter circuit or said 2nd filter circuit according to said frequency setting signal.
[Claim 4] The ultrasonic electrode which comes to provide the radial plane which emits the supersonic wave generated with an ultrasonic vibrator and said ultrasonic vibrator, The oscillator circuit which oscillates and outputs a RF signal, and a magnification means to amplify the output of said oscillator circuit and to output to said ultrasonic electrode, The 1st detection means which detects the electrical potential difference supplied to said ultrasonic electrode, and the value of a current, The 2nd detection means which detects the impedance of said ultrasonic electrode based on the detection result of said 1st detection means, A reference-value setting means to set up which [of the 1st reference value and the 2nd different reference value from this 1st reference value] is chosen, The ultrasonic therapy apparatus which comes to provide a comparison means to measure one of said 1st and 2nd reference value chosen by said reference-value setting means, and the output of said 2nd detection means, and to output a comparison result, and an output reduction means to decrease the output of said magnification means according to the output of said comparison means.
[Claim 5] the ultrasonic electrode possessing an ultrasonic vibrator, the intermittence driving means which drives said ultrasonic electrode intermittently, the continuation driving means which drives said ultrasonic electrode continuously, and a time check -- a circuit and said time check -- the time check of a circuit -- the ultrasonic therapy apparatus which comes to provide the change means which changes said intermittence driving means and said continuation driving means according to time amount.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the ultrasonic therapy apparatus which can perform ultrasonic therapy by different various approaches by one set of an ultrasonic therapy apparatus.
[0002]
[Description of the Prior Art] Conventionally, the warm temperature therapy which softens a symptom is known by warming the affected part of patients, such as a peripheral vessel failure, rheumatism, or arthralgia. As an instrument used for such a warm temperature therapy, an ultrasonic therapy apparatus, VHF therapy equipment, and an ultrahigh frequency (microwave) therapy machine are known. Among these, an ultrasonic therapy apparatus carries out resonance vibration of the ultrasonic vibrator by the excitation circuit, and emits alternatively the supersonic wave generated by it to the affected part. And this ultrasonic therapy apparatus has the best ****** among the instruments for a warm temperature therapy mentioned above, and can improve the metabolism of a part according to the deep part massage effectiveness and the high warm temperature effectiveness of ******. This ultrasonic therapy apparatus holds inside a tip the body of an ultrasonic therapy apparatus which consists of an oscillator circuit, an output-control circuit, etc., and the ultrasonic vibrator mentioned above, and is constituted by the connection which consists of electric wires of a metal with the flexibility which connects structurally the ultrasonic electrode which has at a tip the radial plane which emits a supersonic wave, and the body of an ultrasonic therapy apparatus and the ultrasonic electrode connected electrically, such as a tube. And a supersonic wave is emitted to the affected part by pressing the acoustic emission side of the ultrasonic electrode against the affected part. Moreover, the supersonic wave has the description that the degrees of ** of the warm temperature effectiveness change with frequencies. Taking advantage of this description, with the ultrasonic therapy apparatus, a supersonic wave with an oscillation frequency of 3MHz is used for the therapy of the body surface section, and the supersonic wave with an oscillation frequency of 1MHz is used for the therapy of a body deep part, for example.
[0003] By the way, the most will be reflected by air although it is easy to penetrate the supersonic wave emitted from the radial plane of the ultrasonic electrode mentioned above on the body. If the reflection factor in a radial plane becomes high, the temperature of an ultrasonic electrode front face will rise, and when the ultrasonic electrode contacts the body in this condition, a possibility that a low-temperature burn may occur is in a contact part. In order to prevent it, while detecting the reflection factor of the supersonic wave in a radial plane and emitting the supersonic wave, when a reflection factor becomes high, the overheating prevention function to decrease a radiation output is prepared in the ultrasonic therapy apparatus.
[0004] Now, there is a property that the value changes with the reflection factors of the supersonic wave of a radial plane in the input impedance of an ultrasonic vibrator terminal. Generally detection of the reflection factor of the supersonic wave in a radial plane is indirectly performed by asking for input PIDANSU of an ultrasonic vibrator using the property. The input impedance of this ultrasonic vibrator can detect the input voltage and the input current of an ultrasonic vibrator, and can calculate them by the operation from those detection values. However, in an actual therapy, since a certain amount of clearance is generated between a radial plane and the body when the radial plane of the ultrasonic electrode is directly contacted on the body, air enters the clearance and there is a problem that a reflection factor will become high. Then, in order that the ultrasonic electrode may control generating of this clearance, it applies the acoustic wave transparency agent called an acoustic wave coupler to the body, and is usually pressed against the body from on that. Therefore, the criterion of the reflection factor in an above-mentioned overheating prevention function is set up on the assumption that the acoustic wave coupler is applied beforehand. Although the liquid for ultrasonic gel or an underwater therapy is mainly used for this acoustic wave coupler from before, the ointment for

painkilling with viscosity higher than they has also come to be used in recent years.
[0005] On the other hand, as the radiation approach of the supersonic wave in ultrasonic therapy, there are two kinds, the approach of emitting a supersonic wave to the affected part continuously, and the method of emitting a supersonic wave to the affected part intermittently. In ultrasonic therapy, one of the radiation approaches of these supersonic waves is chosen according to the class of disease. Generally the method of emitting a supersonic wave continuously is used for the therapy of chronic disease, and, on the other hand, the method of emitting a supersonic wave intermittently is used for the therapy of acute disease. Moreover, especially in the therapy of rheumatism, the therapy approach which treats by repeating the two radiation approaches, continuation and intermittence, by turns is reported according to the acoustic emission elapsed time under one therapy.
[0006]
[Problem(s) to be Solved by the Invention] By the way, in the conventional ultrasonic therapy apparatus mentioned above, since the oscillation frequency of the excitation circuit which carries out resonance vibration of the ultrasonic vibrator was one kind in one set of an ultrasonic therapy apparatus, when it was going to perform ultrasonic therapy using the supersonic wave of two kinds of different frequencies, two sets of ultrasonic therapy apparatuses with the excitation circuit of a different frequency had to be prepared. Moreover, in the conventional ultrasonic therapy apparatus, actuation of an above-mentioned overheating prevention function is uniformly set up irrespective of the class of acoustic wave coupler. However, it may be used in the latest ultrasonic therapy by the acoustic wave coupler with which above-mentioned classes differ, choosing. In the acoustic wave coupler with which ****s differ, since a difference is in the viscosity of an acoustic wave coupler, even if the contact condition of the body and a radial plane is the same, the reflection factor in the radial plane of a supersonic wave will change with classes of acoustic wave coupler. Therefore, in the conventional overheating prevention function to judge a reflection factor using one common criterion, there was a problem that actuation of an overheating prevention function was inadequate, or actuation was excessive, depending on the class of acoustic wave coupler.
[0007] Furthermore, in the ultrasonic therapy using the conventional ultrasonic therapy apparatus, when the radiation approach of a supersonic wave was switched according to radiation elapsed time, the operator operated the transfer switch prepared in the body of an ultrasonic therapy apparatus each time, and the radiation approach was switched. Therefore, the operator of an ultrasonic therapy apparatus also had to perform the monitor of the therapy part by which it is in contact with the ultrasonic electrode which is separated from the body of an ultrasonic therapy apparatus while operating the transfer switch of the radiation approach which supervised therapy time amount and was formed in the body of an ultrasonic therapy apparatus. Therefore, in the above-mentioned ultrasonic therapy approach performed while switching the radiation approach, there was a problem that actuation of an ultrasonic therapy apparatus was troublesome compared with other therapy approaches.
[0008] This invention was made under such a background and aims at offering the ultrasonic therapy apparatus which can respond to the ultrasonic therapy approach by which the versatility mentioned above differed by one set of an ultrasonic therapy apparatus.
[0009]
[Means for Solving the Problem] The 1st ultrasonic electrode in which invention according to claim 1 has the 1st ultrasonic vibrator, The 2nd ultrasonic electrode which has the 2nd ultrasonic vibrator with which resonance frequency differs from this 1st ultrasonic vibrator, The output terminal in which these [1st] or the 2nd ultrasonic electrode is attached, The oscillator circuit which oscillates and outputs a RF signal, and a magnification means to amplify the output of an oscillator circuit and to output to said output terminal, It is the ultrasonic therapy apparatus which comes to provide the frequency switch means which switches alternatively the oscillation frequency of the RF signal oscillated in an oscillator circuit to either the resonance frequency of said 1st ultrasonic vibrator, or the resonance frequency of said 2nd ultrasonic vibrator.
[0010] Moreover, in invention according to claim 2, said 1st ultrasonic electrode has the 1st resistor. Said 2nd ultrasonic electrode has the 2nd resistor with different resistance from said 1st resistor. The resistance detector which detects the resistance of said 1st resistor or said 2nd resistor with the detection value acquired according to the resistance ratio of said 1st resistor or said 2nd resistor, and the 3rd resistor prepared beforehand, It is the ultrasonic therapy apparatus according to claim 1 characterized by providing a frequency setting signal output means to output the frequency setting signal which switches said frequency switch means according to the detection result of said resistance detector.
[0011] Moreover, the 1st filter circuit where invention according to claim 3 reduces the harmonic content of the output of said magnification means, and this 1st filter circuit are ultrasonic therapy apparatuses according to claim 2 characterized by providing the 2nd filter circuit which has different cut-off frequency and reduces the harmonic content

of the output of a magnification means, and a filter circuit switch means to choose either said 1st filter circuit or said 2nd filter circuit according to said frequency setting signal.
[0012] Moreover, the ultrasonic electrode to which invention according to claim 4 comes to provide the radial plane which emits the supersonic wave generated with an ultrasonic vibrator and said ultrasonic vibrator, The oscillator circuit which oscillates and outputs a RF signal, and a magnification means to amplify the output of this oscillator circuit and to output to said ultrasonic electrode, The 1st detection means which detects the electrical potential difference supplied to said ultrasonic electrode, and the value of a current, The 2nd detection means which detects the impedance of said ultrasonic electrode based on the detection result of said 1st detection means, A reference-value setting means to set up which [of the 1st reference value and the 2nd different reference value from this 1st reference value] is chosen, A comparison means to measure one of said 1st and 2nd reference value chosen by said reference-value setting means, and the output of said 2nd detection means, and to output a comparison result, It is the ultrasonic therapy apparatus which comes to provide an output reduction means to decrease the output of said magnification means according to the output of said comparison means.
[0013] moreover, the ultrasonic electrode in which invention according to claim 5 possesses an ultrasonic vibrator, the intermittence driving means which drives said ultrasonic electrode intermittently, the continuation driving means which drives said ultrasonic electrode continuously, and a time check -- a circuit and said time check -- the time check of a circuit -- it is the ultrasonic therapy apparatus which comes to provide the change means which changes said intermittence driving means and said continuation driving means according to time amount.
[0014]
[Function] In the ultrasonic therapy apparatus by this invention, when the 1st ultrasonic electrode is attached in the output terminal of an ultrasonic therapy apparatus, an oscillator circuit oscillates the RF signal of the same frequency as the resonance frequency of the 1st ultrasonic vibrator with which the 1st ultrasonic electrode was equipped chosen by the frequency switch means, and outputs it to a magnification means. A magnification means amplifies an input signal and supplies the same RF output of a frequency as the resonance frequency of the 1st ultrasonic vibrator to the 1st ultrasonic electrode. With the RF output supplied from the magnification means, the 1st ultrasonic electrode vibrates the 1st ultrasonic vibrator, and generates a supersonic wave. On the other hand, when the 2nd ultrasonic electrode is attached in the output terminal of an ultrasonic therapy apparatus, an oscillator circuit oscillates the RF signal of the same frequency as the resonance frequency of the 2nd ultrasonic vibrator with which the 2nd ultrasonic electrode was equipped chosen by the frequency switch means, and outputs it to a magnification means. A magnification means amplifies an input signal and supplies the RF output of the same frequency as the resonance frequency of the 2nd ultrasonic vibrator to the 2nd ultrasonic electrode. With the RF output supplied from the magnification means, the 2nd ultrasonic electrode vibrates the 2nd ultrasonic vibrator, and generates a supersonic wave. Therefore, in the ultrasonic therapy apparatus of this invention, the supersonic wave of a different frequency using one set of an ultrasonic therapy apparatus can be generated by choosing one of the ultrasonic electrode equipped with the ultrasonic vibrator of two kinds of different resonance frequency, and attaching in the output terminal of an ultrasonic therapy apparatus.
[0015] Moreover, a resistance detector detects the resistance of the 1st and 2nd resistor with the detection value acquired according to the resistance ratio of the 1st and 2nd resistor prepared in the 1st and 2nd ultrasonic electrode, and the 3rd resistor prepared beforehand. According to the detection result of this resistance detector, a frequency setting signal output means outputs the frequency setting signal which switches said frequency switch means. That is, by detecting the resistance of a resistor prepared in the 1st and 2nd ultrasonic electrode, it is distinguished which [of the 1st and 2nd ultrasonic electrode] is attached in an output terminal, and the oscillation frequency of an oscillator circuit is chosen by the result so that it may be in agreement with the resonance frequency of the 1st or 2nd ultrasonic vibrator.
[0016] Moreover, a filter circuit switch means chooses one of the 1st and 2nd filter circuit which reduces the harmonic content of the output of a magnification means according to said frequency setting signal. That is, according to the 1st or 2nd ultrasonic electrode attached in the output terminal, the 1st or 2nd filter circuit prepared corresponding to the resonance frequency of each ultrasonic vibrator is chosen, and the harmonic content of the RF output supplied to the 1st or 2nd ultrasonic electrode is reduced.
[0017] Moreover, in the ultrasonic therapy apparatus of this invention, when the 1st reference value is chosen by the reference-value setting means and the impedance detected by said 2nd detection means is higher than the 1st reference value, an output reduction means operates and the output of an output-control circuit is reduced. On the other hand, by the reference-value setting means, when the 2nd reference value is chosen and the impedance detected by said 2nd detection means is higher than the 2nd reference value, said output reduction means operates and the output of said output-control circuit is reduced. Therefore, the overheating prevention function of the above-mentioned ultrasonic

electrode can be made to always fully act, without being influenced by the difference of the reflection factor of an acoustic wave coupler by changing a setup of a reference-value setting means according to the class of two kinds of acoustic wave couplers which have the property of a reflection factor that ****s differ.
[0018] furthermore, the ultrasonic therapy apparatus of this invention -- setting -- a time check -- the time check of a circuit -- since it drives according to time amount while the ultrasonic electrode switches intermittently or continuously, while a supersonic wave changes from the ultrasonic electrode by turns intermittently or continuously, it emanates.
[0019]
[Example] Hereafter, one example of this invention is explained with reference to a drawing. Drawing 1 is the block diagram showing the configuration of the ultrasonic therapy apparatus by one example of this invention. The ultrasonic therapy apparatus which is one example of this invention shown in this drawing is constituted by the body 1 of an ultrasonic therapy apparatus, and the ultrasonic electrode 2. The body 1 of an ultrasonic therapy apparatus outputs the RF alternating current power which drives the ultrasonic electrode 2. The ultrasonic electrode 2 consists of the ultrasonic vibrator 201 which inputs the RF alternating current power outputted from the body 1 of an ultrasonic therapy apparatus, and generates a supersonic wave, the radial plane (not shown) of a supersonic wave, and the resistor 202 used in order to identify the class of ultrasonic vibrator 201. The main components of the body 1 of an ultrasonic therapy apparatus are the power circuit 101 which transforms into two or more predetermined electrical-potential-difference power sources the power source (commercial 100V AC power supply) supplied from the outside, and supplies it to each circuit section mentioned later, the controller 102 which controls each part, the oscillator circuit 103 which oscillates the RF signal of the resonance frequency of an ultrasonic vibrator 201, and the output-control circuit 105 which amplifies the RF signal which is the output of an oscillator circuit 103 in predetermined magnitude, and supply RF alternating current power to the ultrasonic electrode 2. By the above configuration, according to the power source supplied from the outside, the body 1 of an ultrasonic therapy apparatus oscillates a RF signal, carries out magnification control, and generates RF alternating current power. And by inputting the RF alternating current power generated by the above-mentioned body 1 of an ultrasonic therapy apparatus, and driving an ultrasonic vibrator 201, the ultrasonic electrode 2 generates a supersonic wave and emits a supersonic wave to the affected part from the radial plane prepared in the front face of an ultrasonic vibrator 201. Furthermore, by connecting either to the body 1 of an ultrasonic therapy apparatus for two kinds of ultrasonic electrode 2 which consists of the ultrasonic vibrator 201 of different resonance frequency alternatively using the connector in which repeat installation and removal are possible, the ultrasonic therapy apparatus in this example is supplied to the ultrasonic electrode 2 which had RF alternating current power chosen by the output-control circuit 105, and it is constituted so that the supersonic wave of two kinds of different frequencies can be generated.
[0020] Next, the detail of the body 1 of an ultrasonic therapy apparatus shown in drawing 1 and the ultrasonic electrode 2 is explained below. In drawing 1 , the power source (commercial 100V AC power supply) supplied from the outside is transformed into two or more predetermined electrical-potential-difference power sources, and a power circuit 101 supplies it to each circuit section mentioned later. Moreover, the power circuit 101 is equipped with the reset signal generating circuit which generates the reset signal the electric power switch for the operator of an ultrasonic therapy apparatus operating it, and switching on or intercepting commercial 100V AC power supply, and for being further constituted by a resistor, a capacitor, diode, etc. and initializing a controller 102 to a power up. The supply power sources to each circuit section of a power circuit 101 are the power source of direct-current 5V used as the power source of each I/O circuit section of DC power supply INP 1 used as the input power of the output-control circuit 105, a controller 102, and a controller 102, a power source of positive/negative direct-current 12V used in the other circuit sections.
[0021] A controller 102 CPU (central processing unit), ROM (read-only memory), RAM (random access memory), an A-D converter with two or more input terminals (analog-digital converter), A D-A converter with two or more output terminals (digital-to-analog converter), Had the oscillator circuit which generates an internal clock signal using the external capacitors 115 and 116 and external crystal oscillator 117 which were connected to two or more digital-input/output terminals, two or more timer circuits, and terminals X1 and X2. It is constituted by the 8 bit microprocessor of one chip. The terminal AD 1 and Terminal AD 2 of a controller 102 of the analog input terminal of an A-D converter, a terminal DA 1, and a terminal DA 2 are [the analog output terminal of a D-A converter, terminals P1 and P2, --P11] 1-bit digital-input/output terminals. The detail of the I/O signal of each terminal is explained later.
[0022] An oscillator circuit 103 is an oscillator circuit which oscillates a RF signal, switches two kinds of different frequencies, and oscillates. Signal FREF is a RF signal (5V RF pulse signal) which is the output of an oscillator circuit, and is inputted into the output-control circuit 105. Signal FSEL is a digital signal for switching an oscillation frequency, and is the output of the digital output terminal P1 of a controller 102. The configuration of the internal

circuitry of an oscillator circuit 103 is explained here using drawing 2 (b). In drawing 2 (b), 103a is a comparator, a forward side power supply terminal is connected to 5V power source, and the negative side power supply terminal is connected to the gland. 103c and 103d are resistors, and determines the charge and discharge current of capacitor 103e connected to the negative input terminal of comparator 103a. Resistors 103f, 103g, and 103h are resistors which set up the electrical-potential-difference value inputted into the plus input terminal of comparator 103a. 103b is an analog switch which a switch closes when digital signal FSEL is "1", and a switch opens at the time of "0." This analog switch 103b connects resistor 103c and 103d of both resistors to juxtaposition at capacitor 103e, when the switch has closed, and when the switch is open, it connects only 103d of resistors to capacitor 103e. By the above configuration, an oscillator circuit 103 is the frequency of 3MHz, when digital signal FSEL is "1" by setting Resistors 103c and 103d and capacitor 103e as a predetermined value, and when digital signal FSEL is "0", it outputs the RF signal FREF with a frequency of 1MHz.

[0023] 104 is an output mode setting circuit and is outputted as analog signal VREF inputted into the output-control circuit 105 according to output analog signal VLVL of the change-over circuit 114 mentioned later, and digital signal SGLM outputted from the terminal P2 of a controller 102. The output mode setting circuit 104 consists of the same analog switches 104a and 104b as analog switch 103b mentioned above, and inverter 104c, when digital signal SGLM is "1", it outputs the analog signal pressure VLVL to analog signal VREF as it is, and when digital signal SGLM is "0", it outputs a grand electrical potential difference (0V) as analog signal VREF, as shown in the drawing 2 (**).

[0024] The output-control circuit 105 amplifies the RF signal FREF which an oscillator circuit 103 outputs in predetermined magnitude, and supplies alternating current power to the ultrasonic electrode 2. This output-control circuit 105 consists of the following two main components. The 1st main component is the armature-voltage control section VS which adjusts the electrical-potential-difference value of DC power supply INP 1 which are the outputs of a power circuit 101 by making output analog signal VREF of the output mode setting circuit 104 into a command value, and outputs the direct-current constant supply of a predetermined electrical potential difference. The 2nd main component is the RF signal amplifier HA which changes the direct-current constant supply which is the output of the armature-voltage control section VS into the RF AC power supply which is the output of an oscillator 103, and which synchronized with the RF signal FREF. Next, the 1st of the output-control circuit 105 and the 2nd component detail which were mentioned above are explained using drawing 2 (Ha).

[0025] In drawing 2 (Ha), the armature-voltage control section VS which is the 1st main component of the above-mentioned output-control circuit 105 is constituted by the switching regulator which adjusts the electrical potential difference of DC power supply INP 1, and obtains the direct-current constant supply of a predetermined electrical potential difference to capacitor 105g both ends. This switching regulator Power transistor 105b, inductance 105f, Capacitor 105g, the power section which consists of diode 105e, and resistor 105c which is the base resistance of power transistor 105b, Transistor 105d which carries out on-off control of the base current of power transistor 105b which flows through resistor 105c, It responds to the partial pressure electrical potential difference and analog signal VREF of 2 105h 1 and 105h [of resistors] 2 and 105h [of resistors] 1 and 105h of resistors of resistors which pressure partially capacitor 105g terminal voltage. It is constituted by the signal section which consists of switching regulator control circuit 105a which carries out on-off control of the transistor 105d. This switching regulator control circuit 105a is constituted by the analogue integrated circuit for switching regulator control which consists of a triangular wave oscillator, an operational amplifier, etc., a resistor, the capacitor, etc. By making the electrical potential difference of an input terminal 105a1 (analog signal VREF) into reference voltage, switching regulator control circuit 105a carries out on-off control of the transistor 105d with the output from an output terminal 105a3 so that the electrical-potential-difference value of an input terminal 105a2 (resistor 105h1 and partial pressure electrical potential difference of 105h2) may be in agreement with the above-mentioned reference voltage. By the above configuration, the armature-voltage control section VS adjusts DC power supply INP 1 according to analog signal VREF, and outputs it as a direct-current constant supply of a predetermined electrical potential difference from capacitor 105g both ends.

[0026] The RF signal amplifier HA which is the 2nd main component of the output-control circuit 105 is constituted by circuits other than the armature-voltage control section VS which is the 1st component which drawing 2 (Ha) mentioned above. 105i1 and 105 i2 of the RF signal amplifier HA which show in drawing are a pulse transformer, the end of both upstream coil is connected to a serial, and one other end of an upstream coil is connected to direct-current 12V power source, and another other end is connected to the MOSFET(metal oxide film field-effect transistor)105m drain. When the RF signal FREF inputted into the gate is "1", between the drain-source turns on MOSFET105m, and when it is "0", it is turned off. The secondary coil of a pulse transformer 105i1 is connected between the gate-source of MOSFET 105k1, and to the both ends of a resistor 105j1. Each terminal of the secondary coil of pulse transformer 105 i2 is connected between the gate-source of MOSFET 105k2, and to the both ends of a resistor 105j2. A pulse

transformer 105i1 is a reverse Maki transformer, and pulse transformer 105 i2 is a **** transformer. 105l., 105l., 2 is diode, and 1 and in case MOSFET 105k1 and 105k2 carry out an on-off action, it operates so that reverse voltage may not be impressed between MOSFET 105k1 and the drain-source of 105k2. By this configuration, when the RF signal FREF is "1", MOSFET 105k1 turns off, and it operates so that MOSFET 105k2 may turn on. On the contrary, when the RF signal FREF is "0", MOSFET 105k1 turns on, and it operates so that MOSFET 105k2 may turn off. Therefore, an outputting-from capacitor 105g [of the armature-voltage control section VS] both ends direct-current constant supply is changed into the RF pulse power source which synchronized with the RF signal FREF, and is outputted between the drain-sources of MOSFET 105k2.

[0027] 105n by which the end was connected to the drain of MOSFET 105k2 is a capacitor, and 105o by which the end was connected to the this capacitor 105n other end is an inductance. These capacitor 105n and inductance 105o constitute a high-pass filter from both. By cutting that dc component and low-frequency component, the RF pulse power source outputted to the drain of MOSFET 105k2 is changed into RF AC power supply, and this high-pass filter outputs it to the both ends of inductance 105o.

[0028] For 105s, 1 and 105s2 are inductances and they constitute low pass filter 105s with capacitor 105s3. An inductance and 105t3 are capacitors and 1 and 105t2 constitute the 105t same low pass filter 105t as low pass filter 105s. Here, the low pass filter 105s cut off frequency is set as the frequency (for example, 1.1MHz) suitable for reducing the harmonic content of RF AC power supply with a frequency of 1MHz, and the low pass filter 105t cut off frequency is set as the frequency (for example, 3.3MHz) suitable for reducing the harmonic content of RF AC power supply with a frequency of 3MHz. 105g is a transistor, is driven by digital signal FSEL inputted through base resistance machine 105p, and switches relay 105r1 and the contact of 105r2. Relay 105r1 and 105r2 operate so that between a high-pass filter and the output terminals OUT1 of the output-control circuit 105 may be connected with one of two kinds of low pass filters. Here, when digital signal FSEL is "1", low pass filter 105t is chosen, and when digital signal FSEL is "0", low pass filter 105s is chosen.

[0029] By the above-mentioned configuration, the output-control circuit 105 adjusts the electrical potential difference of DC power supply INP 1 by making analog signal VREF into a command value by the armature-voltage control section VS mentioned above in the 1st, and it operates so that the direct-current constant supply of a predetermined electrical potential difference may be obtained to capacitor 105g both ends. In addition, analog signal VREF is the voltage signal of grand electrical-potential-difference (0V) -5V, and when analog signal VREF is a grand electrical potential difference, the electrical potential difference of capacitor 105g both ends is adjusted by the output-control circuit 105 so that it may be set to 0V. It changes into a RF pulse power source (output between the drain-sources of MOSFET 105k2) with the wave height electrical potential difference of the direct-current constant supply supplied to the capacitor 105g both ends which are the outputs of the armature-voltage control section VS by the RF signal amplifier HA mentioned above in the 2nd in the RF signal FREF (pulse signal (3MHz or 1MHz)). Furthermore, the above-mentioned RF pulse power source is changed into RF AC power supply (output of the both ends of inductance 105o) by the above-mentioned high-pass filter. This high-frequency ac power source lets low pass filter of 3.3MHz of cut off frequencies 105t pass, when digital signal FSEL is "1", and when digital signal FSEL is "0", it lets low pass filter of 1.1MHz of cut off frequencies 105s pass, and it is outputted from an output terminal OUT1 (the other end of an output terminal is a gland).

[0030] In drawing 1 , 106 is a current detector, detects the alternating current i supplied to an ultrasonic vibrator 201 from output terminals OUT1 and OUT2, and changes and outputs the detected current value to the voltage signal IDET with a predetermined conversion ratio (analog signal). Detection of a current is performed by the amplifying circuit which amplifies sensing elements, such as shunt resistance or a hall device, and the output signal of those, and changes with the operational amplifier to the electrical-potential-difference value of a predetermined ratio to change.

[0031] 107 is an electrical-potential-difference detector, detects the alternating voltage v impressed to an ultrasonic vibrator 201 from output terminals OUT1 and OUT2, and changes and outputs the detected electrical-potential-difference value to the voltage signal VDET with a predetermined conversion ratio (analog signal). Detection of an electrical potential difference is performed by the partial pressure circuit which consists of two or more resistors.

[0032] 108 is a power arithmetic circuit and is constituted by each analog operating circuit, such as an average circuit which consists of the multiplication circuit which consists of the analogue integrated circuit for multiplication and division which accumulated the transistor, the operational amplifier, etc., a resistor, a capacitor, etc., inputs the result of an operation of a multiplication circuit, and calculates the average, and an amplifying circuit which changes the output of an average circuit into a voltage signal with a predetermined conversion ratio. Moreover, analog signal IDET and analog signal VDET are inputted into the multiplication circuit. After changing into a predetermined electrical-potential-difference conversion ratio the result of an operation for which the power arithmetic circuit 108 found the

power p which can be found by alternating current i and alternating voltage v to multiplication, and which is supplied to an ultrasonic vibrator 201 by the above-mentioned analog operating circuit, and asked by the above configuration, it outputs as analog signal PCAL.

[0033] 109 is an impedance arithmetic circuit and is constituted by each analog operating circuit which inputs the result of an operation of the division circuit which consists of the analogue integrated circuit for multiplication and division which accumulated the transistor, the operational amplifier, etc., and a division circuit, and calculates an absolute value, such as an absolute-value circuit which consists of diode, a resistor, a capacitor, etc., and an amplifying circuit which changes the output of an absolute-value circuit into a voltage signal with a predetermined conversion ratio. Moreover, analog signal IDET and analog signal VDET which were mentioned above are inputted into the above-mentioned division circuit. After asking for input-impedance z of an ultrasonic vibrator 201 which can ask for the impedance arithmetic circuit 109 by alternating current i and alternating voltage v to the division by the above-mentioned analog operating circuit and changing into a predetermined electrical-potential-difference conversion ratio this result of an operation for which it asked by the above configuration, it outputs as analog signal ZCAL. The ultrasonic electrode 2 contacts suitable for the affected part, and in this example, when the input impedance of an ultrasonic vibrator 201 is normal, when the class of the above-mentioned acoustic wave coupler is gel, the electrical potential difference below 3V is outputted from analog signal ZCAL, and when the class of acoustic wave coupler is ointment, the above-mentioned constant and above-mentioned electrical-potential-difference conversion ratio of each operation part are set up so that the electrical potential difference below 4V may be outputted from analog signal ZCAL.

[0034] 110 is an output-control circuit and outputs analog signal VNML according to the result of having compared with analog signal PCAL analog signal PREF outputted from the output terminal DA 1 of the D-A converter of a controller 102. Moreover, the output-control circuit 110 is constituted by the operational amplifier etc., when analog signal PCAL is smaller than analog signal PREF, analog signal VNML is enlarged, and on the contrary, when analog signal PCAL is larger than analog signal PREF, it operates so that analog signal VNML may be made small. That is, the output-control circuit 110 fluctuates and outputs analog signal VNML so that analog signal PCAL showing the actual input power of an ultrasonic vibrator 201 may be in agreement with analog signal PREF showing the desired value of the input power of an ultrasonic vibrator 201.

[0035] A comparator circuit 111 is constituted by comparator 111a shown in drawing 2 (d). In drawing 2 (d), analog signal ZREF by which analog signal ZCAL was outputted to the negative input terminal of comparator 111a from the output terminal DA 2 of the D-A converter of a controller 102 again is connected to the plus input terminal of comparator 111a. Therefore, digital signal ZCMP which is the output of a comparator circuit 111 is set to "0" when analog signal ZCAL is larger than analog signal ZREF, and on the contrary, when analog signal ZCAL is smaller than analog signal ZREF, it is set to "1." And in this example, when the class of the above-mentioned acoustic wave coupler is gel, on the other hand, analog signal ZREF is set as 3V 4V, when the class of the above-mentioned acoustic wave coupler is ointment. Thereby, irrespective of the class of the above-mentioned acoustic wave coupler, it contacts suitable for the affected part, the ultrasonic electrode 2 is set to "1" when the input impedance of an ultrasonic vibrator 201 is normal (namely, when the reflection factor in the radial plane of the above-mentioned supersonic wave is low), and digital signal ZCMP is set to "0", when the impedance of an ultrasonic vibrator 201 is unusual (namely, when the reflection factor in the radial plane of the above-mentioned supersonic wave is high).

[0036] The change-over circuit 114 is constituted by analog switches 114a and 114b and inverter 114c as it is shown in drawing 2 (e). And when digital signal VSEL is "1", analog signal VNML is outputted as analog signal VLVL, and when digital signal VSEL is "0", analog signal VLOW is outputted as analog signal VLVL. In addition, analog signal VLOW is a voltage signal determined by the division ratio of resistor 112a and resistor 112b, and in case it reduces the input power of an ultrasonic vibrator 201, it is a signal used as analog signal VREF which is the command value of the output-control circuit 105.

[0037] According to the configuration of the output mode setting circuit 104 and the change-over circuit 114, analog signal VREF which is the command value of the output-control circuit 105 is created as follows by digital signal SGLM and VSEL. First, when digital signal SGLM is "0", analog signal VREF serves as a grand electrical potential difference (0V) irrespective of digital signal VSEL. On the other hand, when digital signal SGLM is "1", when digital signal VSEL is "1", analog signal VNML is set to analog signal VREF according to digital signal VSEL, and when digital signal SGLM is "0", analog signal VLOW is set to analog signal VREF.

[0038] 113 is a resistor and constitutes the potentiometer which pressures 5V power source partially by resistance ratio with a resistor 202. The partial pressure electrical potential difference of this resistor 113 and a resistor 202 is inputted into the input terminal AD 1 of the A-D converter of a controller 102. In this example, the resistance of a resistor 202 prepared in the ultrasonic electrode 2 which consists of the ultrasonic vibrator 201 4.3k ohms and whose resonance

frequency are 1MHz is set as 23k ohms for the resistance of a resistor 202 prepared in the ultrasonic electrode 2 which sets a resistor 113 as 10k ohms, and consists of the ultrasonic vibrator 201 whose resonance frequency is 3MHz. When the ultrasonic electrode 2 for about 3.5V and frequency 1MHz in the electrical-potential-difference value inputted into the terminal AD 1 of a controller 102 by this when the ultrasonic electrode 2 for frequency 3MHz is connected to the body 1 of an ultrasonic therapy apparatus is connected to the body 1 of an ultrasonic therapy apparatus, the electrical-potential-difference value inputted into the terminal AD 1 of a controller 102 is set to about 1.5 V. Moreover, since a resistor 202 cannot constitute a potentiometer with a resistor 113 when the ultrasonic electrode 2 is not normally connected to the body 1 of an ultrasonic therapy apparatus, a grand electrical potential difference (0V) is inputted into the terminal AD 1 of a controller 102.

[0039] As shown in drawing 1 , resistors 118, 119, and 120 and switches 121, 122, and 123 are connected to the digital input terminals P5, P6, and P7 of a controller 102, respectively. The switching condition of these switches 121, 122, and 123 is inputted into a controller 102 as a digital signal as follows. A switch 121 is set as gel, when it is the switch which sets up the class of the above-mentioned acoustic wave coupler, the class of acoustic wave coupler is set as ointment when the switch 121 has closed ("0" is inputted into a terminal P5), and the switch 121 is open ("1" is inputted into a terminal P5).

[0040] The approach a switch 122 emits the radiation approach of the above-mentioned supersonic wave continuously Or when it is a switch for setting up which [of the approach (a pulse mode is called below) of emitting intermittently] it is made and the switch 122 has closed, (Continuous mode is called hereafter) It is set up by continuous mode when ("0" being inputted into a terminal P6) and a switch 122 are open to the pulse mode ("1" is inputted into a terminal P6).

[0041] How (normal mode is called below) to set the radiation approach of the supersonic wave of the above-mentioned [a switch 123] as one one of the modes of continuous mode or a pulse mode, Or it is a switch for setting up which [that emits a supersonic wave while switching continuous mode and a pulse mode by turns according to therapy time amount / of an approach (a program mode is called below)] it is made. the time of the switch 123 having closed -- a program mode -- (-- "0" inputs into a terminal P7 -- having --) -- moreover, when the switch 123 is open, it is set as normal mode ("1" is inputted into a terminal P7).

[0042] 124 is a resistor and is really [switch] which consists of variable-resistor 125a and switch 125b connected to the formal variable resistor 125 and the digital input terminal P8 of a controller 102. The sliding terminal of variable-resistor 125a is connected to the input terminal AD 2 of the A-D converter of a controller 102. This switch 125b is an actuation switch used in case an operator turns on or turns off the output (that is, power inputted into an ultrasonic vibrator 201 from output terminals OUT1 and OUT2) of the body 1 of an ultrasonic therapy apparatus. When the output of the body 1 of an ultrasonic therapy apparatus is set as ON by the controller 102 when actuation switch 125b has closed ("0" inputted into a terminal P8), and the switch is open ("1" inputted into a terminal P8), an output is set up off. Variable-resistor 125a is used in order that an operator may set up the desired value of the input power of the above-mentioned ultrasonic vibrator 201. When the division ratio of variable-resistor 125a is min, electrical-potential-difference value 0V are inputted into an input terminal AD 2, and the desired value (analog signal PREF) of the input power of an ultrasonic vibrator 201 is set as the minimum value by the controller 102. On the other hand, when the division ratio of variable-resistor 125a is max, electrical-potential-difference value 5V are inputted into a terminal AD 2, and the desired value (analog signal PREF) of the input power of an ultrasonic vibrator 201 is set as maximum by the controller 102.

[0043] 126 is a buzzer and is constituted by the piezoelectric device. 127 and 128 are resistors and are respectively connected to light emitting diodes 129 and 130. A buzzer 126 and light emitting diodes 129 and 130 are connected to the output terminal of inverters 131, 132, and 133, respectively. The input terminal of inverters 131, 132, and 133 is connected to the digital output terminals P9, P10, and P11 of a controller 102, respectively. By this, when the digital output terminal P9 is "1", a buzzer turns on, and when it is "0", a buzzer turns off. Moreover, the light emitting diode 129 which displays the supply condition of the input power of the above-mentioned ultrasonic vibrator 201 when the digital output terminal P10 is "1" lights up, and the light is put out when it is "0." Moreover, when the digital output terminal P11 is "1", the light emitting diode 130 which displays the class of the above-mentioned ultrasonic electrode 2 lights up, and the light is put out when it is "0." In addition, in this example, when it indicates that the input power of the above-mentioned ultrasonic vibrator 201 is normally supplied when light emitting diode 129 lights up and light emitting diode 130 lights up, it indicates that the frequency of the above-mentioned ultrasonic vibrator 201 is 3MHz.

[0044] Below, actuation of the above-mentioned controller 102 is explained with reference to the flow chart shown in drawing 3 and drawing 4 . Drawing 3 is a flow chart showing the outline of the main program of the above-mentioned controller 102, and drawing 4 is a flow chart showing the outline of three kinds of subprograms called from the main program shown in drawing 3 . 5V power source is supplied to a controller 102 from a power circuit 101, and further,

the main program shown in drawing 3 is started, after a reset signal is inputted. First, in step S1, initial setting, such as a setup of the A-D converter of the controller 102 interior, a setup of a D-A converter, a setup of the I/O direction of a digital-input/output terminal, and a setup of a timer circuit, is performed. Furthermore in step S1, the output of a D-A converter and the output of a digital output terminal are initialized by 0V and "0", respectively.

[0045] Next, if it progresses to step S2, reading of the condition of actuation switch 125b will be performed. At step S2, when actuation switch 125b changes into the condition (namely, digital input terminal P8="0") of ON, a setup which enables actuation switch interruption processing with initial setting of the actuation switch interruption processing generated when actuation switch 125b next turns off is performed. In addition, in actuation switch interruption processing, when actuation switch 125b turns off, processing jumped to step S1 is performed. Processing which turns off the output of an ultrasonic therapy apparatus irrespective of the operating state of the timer 1 later mentioned by actuation switch interruption processing by this when an operator turns off actuation switch 125b, and a timer 2 ("0" is outputted from the digital output terminal P2.) That is, digital signal SGLM is set as "0". It is carried out.

[0046] Next, at step S3, the electrical potential difference of an input terminal AD 1 is read, and the class (frequency) of ultrasonic electrode 2 is judged with the value. And according to the frequency of the judged ultrasonic vibrator 201, digital signal VSEL is set up as follows. When the frequency of an ultrasonic vibrator 201 is 3MHz, digital signal VSEL is set as "1" (namely, when an input terminal AD 1 is about 3.5V (3V-4V)). On the other hand, when the frequency of an ultrasonic vibrator 201 is 1MHz, digital signal VSEL is set as "0" (namely, when an input terminal AD 1 is about 1.5V (1V-2V)). And only when the frequency of an ultrasonic vibrator 201 is 3MHz, processing which outputs "1" from the digital output terminal P11, and turns on light emitting diode 130 is performed. Moreover, in step S3, when the electrical potential difference of an input terminal AD 1 is less than [1V], after the above-mentioned ultrasonic electrode 2 judges that it is in the condition which is not normally connected to the body 1 of an ultrasonic therapy apparatus, outputs "1" from the digital output terminal P9 and turns on a buzzer 126, a main program is ended. In addition, when a main program is completed in a controller 102, the reboot of a main program is performed by the actuation switch interruption processing generated when a reset signal is inputted into a controller 102 or actuation switch 125b turns off.

[0047] Next, if it progresses to step S4, the condition of a switch 121 (input signal of the digital input terminal P5) will be read, and the class of the above-mentioned acoustic wave coupler will be judged with the value. And according to the class of judged acoustic wave coupler, it is carried out as a setup of the output voltage of an output terminal DA 2 is the following. That is, since a setup of the class of acoustic wave coupler is ointment when the switch 121 turns on, a setup which outputs 4V from an output terminal DA 2 is performed. On the other hand, since a setup of the class of acoustic wave coupler is gel when the switch 121 turns off, a setup which outputs 3V from an output terminal DA 2 is performed.

[0048] Next, if it progresses to step S5, normal mode or a program mode will be judged for the radiation approach of a supersonic wave based on the condition of a switch 123 (DETARU input terminal P7). And when a setup of the radiation approach is normal mode, it progresses to step S6 (when it is digital input terminal P7="1").

[0049] At step S6, it is set as the timer 1 which is one of the timer circuits in which all the therapy time amount (therapy end time) in one therapy of the ultrasonic therapy apparatus mentioned above was contained by the controller 102, and actuation of a timer 1 is started. In addition, the timer circuit ended actuation, when it went through the time amount set up from initiation of operation, and it is equipped with the circuit which carries out storage maintenance of the termination of operation further. A timer 1 is set up in 15 minutes and made to start actuation at step S6 here.

[0050] Next, if it progresses to step S7, continuous mode or a pulse mode will be judged for the radiation approach of a supersonic wave based on the condition of a switch 122 (digital input terminal P6). And when a setup of the radiation approach is continuous mode, it progresses to a continuous mode subprogram at step S8 (when it is digital input terminal P6="1"). In addition, about this continuous mode subprogram, it mentions later. And after this continuous mode subprogram is completed, it progresses to step S11 next.

[0051] At step S11, while setting the digital output terminals P2, P9, P10, and P11 to "0" and turning off radiation of a supersonic wave, light emitting diodes 129 and 130 are switched off, and a buzzer 126 is turned off. And a main program is ended.

[0052] On the other hand, at step S7 mentioned above, when a setup of the radiation approach is a pulse mode, it progresses to a pulse mode subprogram by step S9 (when it is digital input terminal P6="0"). And after a pulse mode subprogram is completed, it progresses to step S11 mentioned above.

[0053] On the other hand, in step S5 mentioned above, when the radiation approach is a setup of a program mode, it progresses to a program mode subprogram at step S10 (when it is digital input terminal P7="0"). And after a program mode subprogram is completed, it progresses to step S11 mentioned above.

[0054] next, the flow of the program of a continuous mode subprogram, a pulse mode subprogram, and a program mode subprogram -- respectively -- the drawing 4 (**) and (**) -- and (Ha) it refers to and explains. Drawing 4 (b) is the flow chart of a continuous mode subprogram. In this continuous mode subprogram, it is a step SA 1 first and the judgment of whether actuation of a timer 1 is completed is performed. And when actuation of a timer 1 is completed, it returns from a continuous mode subprogram to the program which called this program. In the judgment of the another side step SA 1, when actuation of a timer 1 is not completed, it progresses to a step SA 2. At a step SA 2, processing of item (1) - (3) shown below is performed. In a step SA 2, after the following processings are completed, it returns to a step SA 1.

[0055] (1) Output as analog signal PREF from an output terminal DA 1 after reading the desired value of the input power of an ultrasonic vibrator 201 set up by variable-resistance 125a at any time (namely, the electrical-potential-difference value of an input terminal AD 2 reading) and performing predetermined conversion and amendment. Moreover, digital signal SGLM and digital signal VSEL (digital output terminals P2 and P3) are set as "1." Thereby, except the condition decided by degree item (2), the input command value VREF of the output-control circuit 105 is determined according to a setup and analog signal PCAL of analog signal PREF (namely, variable-resistance 125a). Moreover, the idle state of a timer 1 of operation is canceled.

[0056] (2) While setting the command value of the output-control circuit 105 as min when the supersonic wave is emitted, and the condition which is not normal continues more than for 0.5 seconds, suspend actuation of a timer 1. That is, a setup of a digital SGLM signal is "1" (digital output terminal P2="1"). And once the condition that digital signal ZCMP (digital input terminal P4) is "0" is materialized, When [which the condition that digital signal SGLM was "1" and digital signal ZCMP was "1" continued more than for 0.5 seconds] not materialized, while setting digital signal VSEL (digital output terminal P3) to "0", actuation of a timer 1 is suspended. Moreover, when the condition that digital signal SGLM is "1" and digital signal ZCMP is "1" is materialized, digital signal VSEL is set to "1."

[0057] (3) When digital signal VSEL is "1", processing ("0" is outputted from a digital output P9) which turns on the light emitting diode 129 which displays the supply condition of the input power of an ultrasonic vibrator 201 ("1" is outputted from a digital output P10), and turns off a buzzer 126 is performed. On the other hand, when digital signal VSEL is "0", processing ("1" is outputted from a digital output P9) which switches off a light emitting diode 129 ("0" is outputted from a digital output P10), and turns on a buzzer 126 is performed.

[0058] Next, the flow of the program of a pulse mode subprogram is explained with reference to drawing 4 (b). At the step SB 1 of a pulse mode subprogram, the judgment of whether actuation of a timer 1 is completed is performed like the step SA 1 of a continuous mode subprogram. And when actuation of a timer 1 is completed, it returns from a pulse mode subprogram to the program which called this program. In the judgment of the another side step SB 1, when actuation of a timer 1 is not completed, it progresses to a step SB 2. Next, at a step SB 2, processing (2) in processing (1)' shown below and the step SA 2 mentioned above and the same processing as (3) are performed. And it returns to a step SB 1.

[0059] Hereafter, processing of item (1)' in a step SB 2 is explained.

(1) After reading the desired value of the input power of an ultrasonic vibrator 201 set up by 'variable-resistance 125a at any time (namely, the input voltage value of an input terminal AD 2 reading) and performing predetermined conversion and amendment, it outputs as analog signal PREF from an output terminal DA 1. Furthermore, from digital signal SGLM (namely, digital output terminal P2), "1" and "0" are repeated intermittently, and are outputted. Here, after "0" is outputted between 8ms of time amount, the intermittent output signal with which "1" is outputted between 2ms of time amount is repeatedly outputted as digital signal SGLM. Moreover, digital signal VSEL (namely, digital output terminal P3) is set as "1." Thereby, except the condition decided by processing (2) of a step SA 2, the input command value of the output-control circuit 105 is determined according to a setup of analog signal PREF (namely, variable-resistance 125a). And a timer 1 is set as operating state.

[0060] Next, the flow of the program of a program mode subprogram mentioned above is explained with reference to drawing 4 (Ha). In a program mode subprogram, a setup of a timer 1 and the timer 2 which is the same timer circuit is first performed at a step SC 1. A timer 2 is set up in 15 minutes and actuation is made to start it at a step SC 1. Next, at a step SC 2, it judges whether actuation of a timer 2 is completed. When actuation of a timer 2 is completed in a step SC 2, it returns from a program mode subprogram to the program which called this program.

[0061] On the other hand, in the judgment of a step SC 2, when actuation of a timer 2 is not completed, it progresses to a step SC 3. At a step SC 3, processing of a timer 1 is performed like step S6. However, at a step SC 3, a timer 1 is set up in 1 minute. Next, if it progresses to a step SC 4, it will progress to the continuous mode subprogram mentioned above. After a continuous mode subprogram is completed, it progresses to a step SC 5. At a step SC 5, processing of a timer 1 is performed like a step SC 3. At a step SC 5, a timer 1 is set up in 1 minute like a step SC 3. Next, it progresses

to a pulse mode subprogram at a step SC 6. After a pulse mode subprogram is completed, it returns to a step SC 2.
[0062] Next, actuation of the ultrasonic therapy apparatus by the above-mentioned configuration is explained according to a condition.
(b) If actuation switch 125b is turned on after an operator connects the ultrasonic electrode 2 with a frequency of 3MHz to the body 1 of an ultrasonic therapy apparatus, and turn on the electric power switch of a power circuit 101, turning ON a switch 121, setting the class of acoustic wave coupler as ointment, turning OFF a switch 122 and a switch 123 and setting up the radiation approach of the supersonic wave of continuous mode beforehand, a supersonic wave with a frequency of 3MHz will be emitted from the ultrasonic electrode 2. Here, an ultrasonic therapy apparatus turns on light emitting diode 129, and it indicates that the supersonic wave is emitted normally, and light emitting diode 130 is turned on and it indicates that the frequency of a supersonic wave is 3MHz. The supply voltage to the ultrasonic electrode 2, i.e., the radiation output of a supersonic wave, is adjusted when an operator operates resistor 125a. If contact on the ultrasonic electrode 2 and the body comes out enough, and the therapy elapsed time after actuation switch 125b is turned on passes for 15 minutes in a certain case or switch 125b is turned off, radiation of a supersonic wave will turn off and light emitting diodes 129 and 130 will be switched off. After the above actuation is completed, an ultrasonic therapy apparatus suspends actuation. A reboot is performed by turning on again, once it turns off actuation switch 125b or an electric power switch.
[0063] (b) In the above-mentioned (b) of operation, when the ultrasonic electrode 2 with a frequency of 1MHz is connected to the body 1 of an ultrasonic therapy apparatus, a supersonic wave with a frequency of 1MHz is emitted from the ultrasonic electrode 2, and switch off light emitting diode 129.
[0064] (c) In the above-mentioned (b) of operation, when the condition which is not enough continues more than for 0.5 seconds, an ultrasonic output decreases. Moreover, a buzzer 126 turns on in coincidence and light emitting diode 129 puts out the light to it. Then, if the ultrasonic electrode 2, the body, and contact will be in sufficient condition, the radiation output of a supersonic wave will turn into an output adjusted like the above-mentioned (b) of operation when resistor 125a is again operated by the operator. Moreover, a buzzer 126 is turned off and turns on light emitting diode 129. Moreover, when the condition which is not enough continues more than for 0.5 seconds, the radiation output of a supersonic wave decreases. In addition, the time amount to which the radiation output of a supersonic wave is decreasing is not included in the above-mentioned therapy elapsed time for 15 minutes.
[0065] (d) In the above-mentioned (b) of operation, when a switch 122 is turned on beforehand and the acoustic emission approach of a pulse mode is set up, after radiation of a supersonic wave turns off for 8ms, a supersonic wave is repeatedly emitted by the intermittent radiation approach of 10ms of periods turned on for 2ms.
[0066] (e) On the other hand, when a switch 123 is turned on beforehand and the radiation approach of a program mode is set up in the above-mentioned (b) of operation, a supersonic wave winds radiation by the continuous mode for 1 minute, and radiation by the pulse mode for 1 minute by turns with the period for 2 minutes, and is emitted by the ****** approach.
[0067] In addition, in the above-mentioned example, although a setup of the frequency of the ultrasonic electrode 2 is prepared in the ultrasonic electrode 2 and performed using the **** resistor 202, a switch 121 and the same switch are formed and an operator can set up the frequency of a supersonic wave.
[0068] Moreover, although considered as the oscillator circuit which an oscillator circuit 103 switches the two-kind frequency of 3MHz or 1MHz set up beforehand, and can be oscillated in the above-mentioned example In order to amend dispersion in the resonance frequency by the solid-state difference of an ultrasonic vibrator 202 For example, it is good also as an oscillator circuit which enabled it to tune an oscillation frequency finely combining the frequency divider which can carry out adjustable [of the division ratio], and the phase DOROKKU loop-formation oscillator which can switch a basic oscillation frequency to 3MHz and 1MHz by the controller 102.
[0069] Furthermore, in the above-mentioned example, although even free [of the approach of switching by turns the pulse mode to which intermittence time amount was beforehand determined as continuous mode by fixed time amount] is decided beforehand, the radiation approach of the supersonic wave in a program mode is the following, makes the radiation approach in a program mode, and can also be set up. The method of setting up ON and the off rate of the duration of continuous mode, the set point of the magnitude of the ultrasonic output in continuous mode, the duration of a pulse mode and an interruption period, and one interruption period, the set point of the magnitude of the ultrasonic output in a pulse mode, and two or more pulse modes for combination etc. is possible by preparing the key switch group which combined the function key and the ten key as the setting approach of the radiation approach of the supersonic wave in a program mode. Moreover, it is also possible to be the following, to make the output method set up by making it such, and to memorize. Moreover, how to memorize the set point for every symptom of every patient and a disease, using an IC card, a magnetic card, etc. as a store method of a setup of these program modes can be

considered.
[0070] In addition, in the above-mentioned example, although only the frequency of the ultrasonic electrode 2 is distinguished using a resistor 202, discernment of the magnitude of a different radial plane etc. can also be similarly performed using a resistor 202.
[0071] Moreover, although the end time of ultrasonic therapy is beforehand set up in 15 minutes, an operator establishes and does adjustable [of the input means which can be set as arbitration], and may enable it to set it up in this example.
[0072]
[Effect of the Invention] Since it had the frequency switch means which switches alternatively the oscillation frequency of the RF signal oscillated in an oscillator circuit to either the resonance frequency of the 1st ultrasonic vibrator, or the resonance frequency of the 2nd ultrasonic vibrator according to invention according to claim 1 as explained above By choosing one of the 2nd ultrasonic electrode which has the 1st ultrasonic electrode or 2nd ultrasonic vibrator which has the 1st ultrasonic vibrator, and attaching in the output terminal of an ultrasonic therapy apparatus The effectiveness that the supersonic wave of two kinds of frequencies, the resonance frequency of the 1st ultrasonic vibrator or the resonance frequency of the 2nd ultrasonic vibrator, can be generated is acquired by one set of an ultrasonic therapy apparatus.
[0073] Moreover, according to invention according to claim 2, the 1st resistor was prepared in the 1st ultrasonic electrode of the ultrasonic therapy apparatus of invention according to claim 1, and the 2nd resistor with different resistance from the 1st resistor was prepared in the 2nd ultrasonic electrode. Moreover, a frequency setting signal output means to output the frequency setting signal which switches a frequency switch means according to the detection result of the resistance detector which detects the resistance of the 1st and 2nd resistor, and a resistance detector with the detection value acquired according to the resistance ratio of said 1st and 2nd resistor and the 3rd resistor prepared beforehand was established. When this detects the resistance of a resistor prepared in the 1st and 2nd ultrasonic electrode, it is distinguished which [of the 1st and 2nd ultrasonic electrode] is attached in an output terminal, and the oscillation frequency of an oscillator circuit is chosen so that it may be in agreement with the resonance frequency of the 1st or 2nd ultrasonic vibrator. Therefore, an operator chooses one of the 1st or 2nd ultrasonic electrode, and since the oscillation frequency of an oscillator circuit is chosen by attaching in the output terminal of an ultrasonic therapy apparatus, the effectiveness of it becoming unnecessary for an operator to set up the frequency of a supersonic wave anew is acquired.
[0074] Moreover, according to invention according to claim 3, the 1st filter circuit which reduces the harmonic content of the output of a magnification means, and the 1st filter circuit established a filter circuit switch means to choose one of the filters of the 2nd filter circuit where cut-off frequencies differ, with the frequency setting signal of invention according to claim 2. The effectiveness that a supersonic wave with little harmonic content which makes a fundamental wave resonance frequency of the ultrasonic vibrator of the ultrasonic electrode attached in the output terminal by this is emitted is acquired.
[0075] Moreover, according to invention according to claim 4, said comparison means compared one of the 1st or 2nd reference values chosen with the reference-value setting means, and said output of the 2nd detection means which detects the impedance of the ultrasonic electrode, and an output reduction means to decrease the output of said magnification means according to the output of this comparison means was established. The effectiveness that the overheating prevention function of the ultrasonic electrode can always fully be used is acquired without being influenced by the difference of the reflection factor of two kinds of acoustic wave couplers which have a different property by an operator's setting up a reference-value setting means according to the class of acoustic wave coupler, and choosing the 1st or 2nd reference value by this.
[0076] moreover -- according to invention according to claim 5 -- a time check -- the time check of a circuit -- since it drives according to time amount while an intermittence driving means and a continuation driving means switch the ultrasonic electrode by turns intermittently or continuously, while an operator looks at time amount, the effectiveness that the flume troublesomeness to which **** must perform switch actuation of the radiation approach of a supersonic wave the degree of capital is lost is acquired.
[0077]

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TECHNICAL FIELD

[Industrial Application] This invention relates to the ultrasonic therapy apparatus which can perform ultrasonic therapy by different various approaches by one set of an ultrasonic therapy apparatus.

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PRIOR ART

[Description of the Prior Art] Conventionally, the warm temperature therapy which softens a symptom is known by warming the affected part of patients, such as a peripheral vessel failure, rheumatism, or arthralgia. As an instrument used for such a warm temperature therapy, an ultrasonic therapy apparatus, VHF therapy equipment, and an ultrahigh frequency (microwave) therapy machine are known. Among these, an ultrasonic therapy apparatus carries out resonance vibration of the ultrasonic vibrator by the excitation circuit, and emits alternatively the supersonic wave generated by it to the affected part. And this ultrasonic therapy apparatus has the best ****** among the instruments for a warm temperature therapy mentioned above, and can improve the metabolism of a part according to the deep part massage effectiveness and the high warm temperature effectiveness of ******. This ultrasonic therapy apparatus holds inside a tip the body of an ultrasonic therapy apparatus which consists of an oscillator circuit, an output-control circuit, etc., and the ultrasonic vibrator mentioned above, and is constituted by the connection which consists of electric wires of a metal with the flexibility which connects structurally the ultrasonic electrode which has at a tip the radial plane which emits a supersonic wave, and the body of an ultrasonic therapy apparatus and the ultrasonic electrode connected electrically, such as a tube. And a supersonic wave is emitted to the affected part by pressing the acoustic emission side of the ultrasonic electrode against the affected part. Moreover, the supersonic wave has the description that the degrees of ** of the warm temperature effectiveness change with frequencies. Taking advantage of this description, with the ultrasonic therapy apparatus, a supersonic wave with an oscillation frequency of 3MHz is used for the therapy of the body surface section, and the supersonic wave with an oscillation frequency of 1MHz is used for the therapy of a body deep part, for example.

[0003] By the way, the most will be reflected by air although it is easy to penetrate the supersonic wave emitted from the radial plane of the ultrasonic electrode mentioned above on the body. If the reflection factor in a radial plane becomes high, the temperature of an ultrasonic electrode front face will rise, and when the ultrasonic electrode contacts the body in this condition, a possibility that a low-temperature burn may occur is in a contact part. In order to prevent it, while detecting the reflection factor of the supersonic wave in a radial plane and emitting the supersonic wave, when a reflection factor becomes high, the overheating prevention function to decrease a radiation output is prepared in the ultrasonic therapy apparatus.

[0004] Now, there is a property that the value changes with the reflection factors of the supersonic wave of a radial plane in the input impedance of an ultrasonic vibrator terminal. Generally detection of the reflection factor of the supersonic wave in a radial plane is indirectly performed by asking for input PIDANSU of an ultrasonic vibrator using the property. The input impedance of this ultrasonic vibrator can detect the input voltage and the input current of an ultrasonic vibrator, and can calculate them by the operation from those detection values. However, in an actual therapy, since a certain amount of clearance is generated between a radial plane and the body when the radial plane of the ultrasonic electrode is directly contacted on the body, air enters the clearance and there is a problem that a reflection factor will become high. Then, in order that the ultrasonic electrode may control generating of this clearance, it applies the acoustic wave transparency agent called an acoustic wave coupler to the body, and is usually pressed against the body from on that. Therefore, the criterion of the reflection factor in an above-mentioned overheating prevention function is set up on the assumption that the acoustic wave coupler is applied beforehand. Although the liquid for ultrasonic gel or an underwater therapy is mainly used for this acoustic wave coupler from before, the ointment for painkilling with viscosity higher than they has also come to be used in recent years.

[0005] On the other hand, as the radiation approach of the supersonic wave in ultrasonic therapy, there are two kinds, the approach of emitting a supersonic wave to the affected part continuously, and the method of emitting a supersonic wave to the affected part intermittently. In ultrasonic therapy, one of the radiation approaches of these supersonic waves is chosen according to the class of disease. Generally the method of emitting a supersonic wave continuously is

used for the therapy of chronic disease, and, on the other hand, the method of emitting a supersonic wave intermittently is used for the therapy of acute disease. Moreover, especially in the therapy of rheumatism, the therapy approach which treats by repeating the two radiation approaches, continuation and intermittence, by turns is reported according to the acoustic emission elapsed time under one therapy.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since it had the frequency switch means which switches alternatively the oscillation frequency of the RF signal oscillated in an oscillator circuit to either the resonance frequency of the 1st ultrasonic vibrator, or the resonance frequency of the 2nd ultrasonic vibrator according to invention according to claim 1 as explained above By choosing one of the 2nd ultrasonic electrode which has the 1st ultrasonic electrode or 2nd ultrasonic vibrator which has the 1st ultrasonic vibrator, and attaching in the output terminal of an ultrasonic therapy apparatus, the effectiveness that the supersonic wave of two kinds of frequencies, the resonance frequency of the 1st ultrasonic vibrator or the resonance frequency of the 2nd ultrasonic vibrator, can be generated is acquired by one set of an ultrasonic therapy apparatus.
[0073] Moreover, according to invention according to claim 2, the 1st resistor was prepared in the 1st ultrasonic electrode of the ultrasonic therapy apparatus of invention according to claim 1, and the 2nd resistor with different resistance from the 1st resistor was prepared in the 2nd ultrasonic electrode. Moreover, a frequency setting signal output means to output the frequency setting signal which switches a frequency switch means according to the detection result of the resistance detector which detects the resistance of the 1st and 2nd resistor, and a resistance detector with the detection value acquired according to the resistance ratio of said 1st and 2nd resistor and the 3rd resistor prepared beforehand was established. When this detects the resistance of a resistor prepared in the 1st and 2nd ultrasonic electrode, it is distinguished which [of the 1st and 2nd ultrasonic electrode] is attached in an output terminal, and the oscillation frequency of an oscillator circuit is chosen so that it may be in agreement with the resonance frequency of the 1st or 2nd ultrasonic vibrator. Therefore, an operator chooses one of the 1st or 2nd ultrasonic electrode, and since the oscillation frequency of an oscillator circuit is chosen by attaching in the output terminal of an ultrasonic therapy apparatus, the effectiveness of it becoming unnecessary for an operator to set up the frequency of a supersonic wave anew is acquired.
[0074] Moreover, according to invention according to claim 3, the 1st filter circuit which reduces the harmonic content of the output of a magnification means, and the 1st filter circuit established a filter circuit switch means to choose one of the filters of the 2nd filter circuit where cut-off frequencies differ, with the frequency setting signal of invention according to claim 2. The effectiveness that a supersonic wave with little harmonic content which makes a fundamental wave resonance frequency of the ultrasonic vibrator of the ultrasonic electrode attached in the output terminal by this is emitted is acquired.
[0075] Moreover, according to invention according to claim 4, said comparison means compared one of the 1st or 2nd reference values chosen with the reference-value setting means, and said output of the 2nd detection means which detects the impedance of the ultrasonic electrode, and an output reduction means to decrease the output of said magnification means according to the output of this comparison means was established. The effectiveness that the overheating prevention function of the ultrasonic electrode can always fully be used is acquired without being influenced by the difference of the reflection factor of two kinds of acoustic wave couplers which have a different property by an operator's setting up a reference-value setting means according to the class of acoustic wave coupler, and choosing the 1st or 2nd reference value by this.
[0076] moreover -- according to invention according to claim 5 -- a time check -- the time check of a circuit -- since it drives according to time amount while an intermittence driving means and a continuation driving means switch the ultrasonic electrode by turns intermittently or continuously, while an operator looks at time amount, the effectiveness that the flume troublesomeness to which **** must perform switch actuation of the radiation approach of a supersonic wave the degree of capital is lost is acquired.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, in the conventional ultrasonic therapy apparatus mentioned above, since the oscillation frequency of the excitation circuit which carries out resonance vibration of the ultrasonic vibrator was one kind in one set of an ultrasonic therapy apparatus, when it was going to perform ultrasonic therapy using the supersonic wave of two kinds of different frequencies, two sets of ultrasonic therapy apparatuses with the excitation circuit of a different frequency had to be prepared. Moreover, in the conventional ultrasonic therapy apparatus, actuation of an above-mentioned overheating prevention function is uniformly set up irrespective of the class of acoustic wave coupler. However, it may be used in the latest ultrasonic therapy by the acoustic wave coupler with which above-mentioned classes differ, choosing. In the acoustic wave coupler with which ****s differ, since a difference is in the viscosity of an acoustic wave coupler, even if the contact condition of the body and a radial plane is the same, the reflection factor in the radial plane of a supersonic wave will change with classes of acoustic wave coupler. Therefore, in the conventional overheating prevention function to judge a reflection factor using one common criterion, there was a problem that actuation of an overheating prevention function was inadequate, or actuation was excessive, depending on the class of acoustic wave coupler.

[0007] Furthermore, in the ultrasonic therapy using the conventional ultrasonic therapy apparatus, when the radiation approach of a supersonic wave was switched according to radiation elapsed time, the operator operated the transfer switch prepared in the body of an ultrasonic therapy apparatus each time, and the radiation approach was switched. Therefore, the operator of an ultrasonic therapy apparatus also had to perform the monitor of the therapy part by which it is in contact with the ultrasonic electrode which is separated from the body of an ultrasonic therapy apparatus while operating the transfer switch of the radiation approach which supervised therapy time amount and was formed in the body of an ultrasonic therapy apparatus. Therefore, in the above-mentioned ultrasonic therapy approach performed while switching the radiation approach, there was a problem that actuation of an ultrasonic therapy apparatus was troublesome compared with other therapy approaches.

[0008] This invention was made under such a background and aims at offering the ultrasonic therapy apparatus which can respond to the ultrasonic therapy approach by which the versatility mentioned above differed by one set of an ultrasonic therapy apparatus.

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MEANS

[Means for Solving the Problem] The 1st ultrasonic electrode in which invention according to claim 1 has the 1st ultrasonic vibrator, The 2nd ultrasonic electrode which has the 2nd ultrasonic vibrator with which resonance frequency differs from this 1st ultrasonic vibrator, The output terminal in which these [1st] or the 2nd ultrasonic electrode is attached, The oscillator circuit which oscillates and outputs a RF signal, and a magnification means to amplify the output of an oscillator circuit and to output to said output terminal, It is the ultrasonic therapy apparatus which comes to provide the frequency switch means which switches alternatively the oscillation frequency of the RF signal oscillated in an oscillator circuit to either the resonance frequency of said 1st ultrasonic vibrator, or the resonance frequency of said 2nd ultrasonic vibrator.
[0010] Moreover, in invention according to claim 2, said 1st ultrasonic electrode has the 1st resistor. Said 2nd ultrasonic electrode has the 2nd resistor with different resistance from said 1st resistor. The resistance detector which detects the resistance of said 1st resistor or said 2nd resistor with the detection value acquired according to the resistance ratio of said 1st resistor or said 2nd resistor, and the 3rd resistor prepared beforehand, It is the ultrasonic therapy apparatus according to claim 1 characterized by providing a frequency setting signal output means to output the frequency setting signal which switches said frequency switch means according to the detection result of said resistance detector.
[0011] Moreover, the 1st filter circuit where invention according to claim 3 reduces the harmonic content of the output of said magnification means, and this 1st filter circuit are ultrasonic therapy apparatuses according to claim 2 characterized by providing the 2nd filter circuit which has different cut-off frequency and reduces the harmonic content of the output of a magnification means, and a filter circuit switch means to choose either said 1st filter circuit or said 2nd filter circuit according to said frequency setting signal.
[0012] Moreover, the ultrasonic electrode to which invention according to claim 4 comes to provide the radial plane which emits the supersonic wave generated with an ultrasonic vibrator and said ultrasonic vibrator, The oscillator circuit which oscillates and outputs a RF signal, and a magnification means to amplify the output of this oscillator circuit and to output to said ultrasonic electrode, The 1st detection means which detects the electrical potential difference supplied to said ultrasonic electrode, and the value of a current, The 2nd detection means which detects the impedance of said ultrasonic electrode based on the detection result of said 1st detection means, A reference-value setting means to set up which [of the 1st reference value and the 2nd different reference value from this 1st reference value] is chosen, A comparison means to measure one of said 1st and 2nd reference value chosen by said reference-value setting means, and the output of said 2nd detection means, and to output a comparison result, It is the ultrasonic therapy apparatus which comes to provide an output reduction means to decrease the output of said magnification means according to the output of said comparison means.
[0013] moreover, the ultrasonic electrode in which invention according to claim 5 possesses an ultrasonic vibrator, the intermittence driving means which drives said ultrasonic electrode intermittently, the continuation driving means which drives said ultrasonic electrode continuously, and a time check -- a circuit and said time check -- the time check of a circuit -- it is the ultrasonic therapy apparatus which comes to provide the change means which changes said intermittence driving means and said continuation driving means according to time amount.

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OPERATION

[Function] In the ultrasonic therapy apparatus by this invention, when the 1st ultrasonic electrode is attached in the output terminal of an ultrasonic therapy apparatus, an oscillator circuit oscillates the RF signal of the same frequency as the resonance frequency of the 1st ultrasonic vibrator with which the 1st ultrasonic electrode was equipped chosen by the frequency switch means, and outputs it to a magnification means. A magnification means amplifies an input signal and supplies the same RF output of a frequency as the resonance frequency of the 1st ultrasonic vibrator to the 1st ultrasonic electrode. With the RF output supplied from the magnification means, the 1st ultrasonic electrode vibrates the 1st ultrasonic vibrator, and generates a supersonic wave. On the other hand, when the 2nd ultrasonic electrode is attached in the output terminal of an ultrasonic therapy apparatus, an oscillator circuit oscillates the RF signal of the same frequency as the resonance frequency of the 2nd ultrasonic vibrator with which the 2nd ultrasonic electrode was equipped chosen by the frequency switch means, and outputs it to a magnification means. A magnification means amplifies an input signal and supplies the RF output of the same frequency as the resonance frequency of the 2nd ultrasonic vibrator to the 2nd ultrasonic electrode. With the RF output supplied from the magnification means, the 2nd ultrasonic electrode vibrates the 2nd ultrasonic vibrator, and generates a supersonic wave. Therefore, in the ultrasonic therapy apparatus of this invention, the supersonic wave of a different frequency using one set of an ultrasonic therapy apparatus can be generated by choosing one of the ultrasonic electrode equipped with the ultrasonic vibrator of two kinds of different resonance frequency, and attaching in the output terminal of an ultrasonic therapy apparatus.
[0015] Moreover, a resistance detector detects the resistance of the 1st and 2nd resistor with the detection value acquired according to the resistance ratio of the 1st and 2nd resistor prepared in the 1st and 2nd ultrasonic electrode, and the 3rd resistor prepared beforehand. According to the detection result of this resistance detector, a frequency setting signal output means outputs the frequency setting signal which switches said frequency switch means. That is, by detecting the resistance of a resistor prepared in the 1st and 2nd ultrasonic electrode, it is distinguished which [of the 1st and 2nd ultrasonic electrode] is attached in an output terminal, and the oscillation frequency of an oscillator circuit is chosen by the result so that it may be in agreement with the resonance frequency of the 1st or 2nd ultrasonic vibrator.
[0016] Moreover, a filter circuit switch means chooses one of the 1st and 2nd filter circuit which reduces the harmonic content of the output of a magnification means according to said frequency setting signal. That is, according to the 1st or 2nd ultrasonic electrode attached in the output terminal, the 1st or 2nd filter circuit prepared corresponding to the resonance frequency of each ultrasonic vibrator is chosen, and the harmonic content of the RF output supplied to the 1st or 2nd ultrasonic electrode is reduced.
[0017] Moreover, in the ultrasonic therapy apparatus of this invention, when the 1st reference value is chosen by the reference-value setting means and the impedance detected by said 2nd detection means is higher than the 1st reference value, an output reduction means operates and the output of an output-control circuit is reduced. On the other hand, by the reference-value setting means, when the 2nd reference value is chosen and the impedance detected by said 2nd detection means is higher than the 2nd reference value, said output reduction means operates and the output of said output-control circuit is reduced. Therefore, the overheating prevention function of the above-mentioned ultrasonic electrode can be made to always fully act, without being influenced by the difference of the reflection factor of an acoustic wave coupler by changing a setup of a reference-value setting means according to the class of two kinds of acoustic wave couplers which have the property of a reflection factor that ****s differ.
[0018] furthermore, the ultrasonic therapy apparatus of this invention -- setting -- a time check -- the time check of a circuit -- since it drives according to time amount while the ultrasonic electrode switches intermittently or continuously, while a supersonic wave changes from the ultrasonic electrode by turns intermittently or continuously, it emanates.

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EXAMPLE

[Example] Hereafter, one example of this invention is explained with reference to a drawing. Drawing 1 is the block diagram showing the configuration of the ultrasonic therapy apparatus by one example of this invention. The ultrasonic therapy apparatus which is one example of this invention shown in this drawing is constituted by the body 1 of an ultrasonic therapy apparatus, and the ultrasonic electrode 2. The body 1 of an ultrasonic therapy apparatus outputs the RF alternating current power which drives the ultrasonic electrode 2. The ultrasonic electrode 2 consists of the ultrasonic vibrator 201 which inputs the RF alternating current power outputted from the body 1 of an ultrasonic therapy apparatus, and generates a supersonic wave, the radial plane (not shown) of a supersonic wave, and the resistor 202 used in order to identify the class of ultrasonic vibrator 201. The main components of the body 1 of an ultrasonic therapy apparatus are the power circuit 101 which transforms into two or more predetermined electrical-potential-difference power sources the power source (commercial 100V AC power supply) supplied from the outside, and supplies it to each circuit section mentioned later, the controller 102 which controls each part, the oscillator circuit 103 which oscillates the RF signal of the resonance frequency of an ultrasonic vibrator 201, and the output-control circuit 105 which amplifies the RF signal which is the output of an oscillator circuit 103 in predetermined magnitude, and supply RF alternating current power to the ultrasonic electrode 2. By the above configuration, according to the power source supplied from the outside, the body 1 of an ultrasonic therapy apparatus oscillates a RF signal, carries out magnification control, and generates RF alternating current power. And by inputting the RF alternating current power generated by the above-mentioned body 1 of an ultrasonic therapy apparatus, and driving an ultrasonic vibrator 201, the ultrasonic electrode 2 generates a supersonic wave and emits a supersonic wave to the affected part from the radial plane prepared in the front face of an ultrasonic vibrator 201. Furthermore, by connecting either to the body 1 of an ultrasonic therapy apparatus for two kinds of ultrasonic electrode 2 which consists of the ultrasonic vibrator 201 of different resonance frequency alternatively using the connector in which repeat installation and removal are possible, the ultrasonic therapy apparatus in this example is supplied to the ultrasonic electrode 2 which had RF alternating current power chosen by the output-control circuit 105, and it is constituted so that the supersonic wave of two kinds of different frequencies can be generated.
[0020] Next, the detail of the body 1 of an ultrasonic therapy apparatus shown in drawing 1 and the ultrasonic electrode 2 is explained below. In drawing 1 , the power source (commercial 100V AC power supply) supplied from the outside is transformed into two or more predetermined electrical-potential-difference power sources, and a power circuit 101 supplies it to each circuit section mentioned later. Moreover, the power circuit 101 is equipped with the reset signal generating circuit which generates the reset signal the electric power switch for the operator of an ultrasonic therapy apparatus operating it, and switching on or intercepting commercial 100V AC power supply, and for being further constituted by a resistor, a capacitor, diode, etc. and initializing a controller 102 to a power up. The supply power sources to each circuit section of a power circuit 101 are the power source of direct-current 5V used as the power source of each I/O circuit section of DC power supply INP 1 used as the input power of the output-control circuit 105, a controller 102, and a controller 102, a power source of positive/negative direct-current 12V used in the other circuit sections.
[0021] A controller 102 CPU (central processing unit), ROM (read-only memory), RAM (random access memory), an A-D converter with two or more input terminals (analog-digital converter), A D-A converter with two or more output terminals (digital-to-analog converter), Had the oscillator circuit which generates an internal clock signal using the external capacitors 115 and 116 and external crystal oscillator 117 which were connected to two or more digital-input/output terminals, two or more timer circuits, and terminals X1 and X2. It is constituted by the 8 bit microprocessor of one chip. The terminal AD 1 and Terminal AD 2 of a controller 102 of the analog input terminal of an A-D converter, a terminal DA 1, and a terminal DA 2 are [the analog output terminal of a D-A converter, terminals

P1 and P2, --P11] 1-bit digital-input/output terminals. The detail of the I/O signal of each terminal is explained later.
[0022] An oscillator circuit 103 is an oscillator circuit which oscillates a RF signal, switches two kinds of different frequencies, and oscillates. Signal FREF is a RF signal (5V RF pulse signal) which is the output of an oscillator circuit, and is inputted into the output-control circuit 105. Signal FSEL is a digital signal for switching an oscillation frequency, and is the output of the digital output terminal P1 of a controller 102. The configuration of the internal circuitry of an oscillator circuit 103 is explained here using drawing 2 (b). In drawing 2 (b), 103a is a comparator, a forward side power supply terminal is connected to 5V power source, and the negative side power supply terminal is connected to the gland. 103c and 103d are resistors, and determines the charge and discharge current of capacitor 103e connected to the negative input terminal of comparator 103a. Resistors 103f, 103g, and 103h are resistors which set up the electrical-potential-difference value inputted into the plus input terminal of comparator 103a. 103b is an analog switch which a switch closes when digital signal FSEL is "1", and a switch opens at the time of "0." This analog switch 103b connects resistor 103c and 103d of both resistors to juxtaposition at capacitor 103e, when the switch has closed, and when the switch is open, it connects only 103d of resistors to capacitor 103e. By the above configuration, an oscillator circuit 103 is the frequency of 3MHz, when digital signal FSEL is "1" by setting Resistors 103c and 103d and capacitor 103e as a predetermined value, and when digital signal FSEL is "0", it outputs the RF signal FREF with a frequency of 1MHz.
[0023] 104 is an output mode setting circuit and is outputted as analog signal VREF inputted into the output-control circuit 105 according to output analog signal VLVL of the change-over circuit 114 mentioned later, and digital signal SGLM outputted from the terminal P2 of a controller 102. The output mode setting circuit 104 consists of the same analog switches 104a and 104b as analog switch 103b mentioned above, and inverter 104c, when digital signal SGLM is "1", it outputs the analog signal pressure VLVL to analog signal VREF as it is, and when digital signal SGLM is "0", it outputs a grand electrical potential difference (0V) as analog signal VREF, as shown in the drawing 2 (**).
[0024] The output-control circuit 105 amplifies the RF signal FREF which an oscillator circuit 103 outputs in predetermined magnitude, and supplies alternating current power to the ultrasonic electrode 2. This output-control circuit 105 consists of the following two main components. The 1st main component is the armature-voltage control section VS which adjusts the electrical-potential-difference value of DC power supply INP 1 which are the outputs of a power circuit 101 by making output analog signal VREF of the output mode setting circuit 104 into a command value, and outputs the direct-current constant supply of a predetermined electrical potential difference. The 2nd main component is the RF signal amplifier HA which changes the direct-current constant supply which is the output of the armature-voltage control section VS into the RF AC power supply which is the output of an oscillator 103, and which synchronized with the RF signal FREF. Next, the 1st of the output-control circuit 105 and the 2nd component detail which were mentioned above are explained using drawing 2 (Ha).
[0025] In drawing 2 (Ha), the armature-voltage control section VS which is the 1st main component of the above-mentioned output-control circuit 105 is constituted by the switching regulator which adjusts the electrical potential difference of DC power supply INP 1, and obtains the direct-current constant supply of a predetermined electrical potential difference to capacitor 105g both ends. This switching regulator Power transistor 105b, inductance 105f, Capacitor 105g, the power section which consists of diode 105e, and resistor 105c which is the base resistance of power transistor 105b, Transistor 105d which carries out on-off control of the base current of power transistor 105b which flows through resistor 105c, It responds to the partial pressure electrical potential difference and analog signal VREF of 2 105h 1 and 105h [of resistors] 2 and 105h [of resistors] 1 and 105h of resistors of resistors which pressure partially capacitor 105g terminal voltage. It is constituted by the signal section which consists of switching regulator control circuit 105a which carries out on-off control of the transistor 105d. This switching regulator control circuit 105a is constituted by the analogue integrated circuit for switching regulator control which consists of a triangular wave oscillator, an operational amplifier, etc., a resistor, the capacitor, etc. By making the electrical potential difference of an input terminal 105a1 (analog signal VREF) into reference voltage, switching regulator control circuit 105a carries out on-off control of the transistor 105d with the output from an output terminal 105a3 so that the electrical-potential-difference value of an input terminal 105a2 (resistor 105h1 and partial pressure electrical potential difference of 105h2) may be in agreement with the above-mentioned reference voltage. By the above configuration, the armature-voltage control section VS adjusts DC power supply INP 1 according to analog signal VREF, and outputs it as a direct-current constant supply of a predetermined electrical potential difference from capacitor 105g both ends.
[0026] The RF signal amplifier HA which is the 2nd main component of the output-control circuit 105 is constituted by circuits other than the armature-voltage control section VS which is the 1st component which drawing 2 (Ha) mentioned above. 105i1 and 105 i2 of the RF signal amplifier HA which show in drawing are a pulse transformer, the end of both upstream coil is connected to a serial, and one other end of an upstream coil is connected to direct-current

12V power source, and another other end is connected to the MOSFET(metal oxide film field-effect transistor)105m drain. When the RF signal FREF inputted into the gate is "1", between the drain-source turns on MOSFET105m, and when it is "0", it is turned off. The secondary coil of a pulse transformer 105i1 is connected between the gate-source of MOSFET 105k1, and to the both ends of a resistor 105j1. Each terminal of the secondary coil of pulse transformer 105 i2 is connected between the gate-source of MOSFET 105k2, and to the both ends of a resistor 105j2. A pulse transformer 105i1 is a reverse Maki transformer, and pulse transformer 105 i2 is a **** transformer. 105l., 105l., 2 is diode, and 1 and in case MOSFET 105k1 and 105k2 carry out an on-off action, it operates so that reverse voltage may not be impressed between MOSFET 105k1 and the drain-source of 105k2. By this configuration, when the RF signal FREF is "1", MOSFET 105k1 turns off, and it operates so that MOSFET 105k2 may turn on. On the contrary, when the RF signal FREF is "0", MOSFET 105k1 turns on, and it operates so that MOSFET 105k2 may turn off. Therefore, an outputting-from capacitor 105g [of the armature-voltage control section VS] both ends direct-current constant supply is changed into the RF pulse power source which synchronized with the RF signal FREF, and is outputted between the drain-sources of MOSFET 105k2.

[0027] 105n by which the end was connected to the drain of MOSFET 105k2 is a capacitor, and 105o by which the end was connected to the this capacitor 105n other end is an inductance. These capacitor 105n and inductance 105o constitute a high-pass filter from both. By cutting that dc component and low-frequency component, the RF pulse power source outputted to the drain of MOSFET 105k2 is changed into RF AC power supply, and this high-pass filter outputs it to the both ends of inductance 105o.

[0028] For 105s, 1 and 105s2 are inductances and they constitute low pass filter 105s with capacitor 105s3. An inductance and 105t3 are capacitors and 1 and 105t2 constitute the 105t same low pass filter 105t as low pass filter 105s. Here, the low pass filter 105s cut off frequency is set as the frequency (for example, 1.1MHz) suitable for reducing the harmonic content of RF AC power supply with a frequency of 1MHz, and the low pass filter 105t cut off frequency is set as the frequency (for example, 3.3MHz) suitable for reducing the harmonic content of RF AC power supply with a frequency of 3MHz. 105g is a transistor, is driven by digital signal FSEL inputted through base resistance machine 105p, and switches relay 105r1 and the contact of 105r2. Relay 105r1 and 105r2 operate so that between a high-pass filter and the output terminals OUT1 of the output-control circuit 105 may be connected with one of two kinds of low pass filters. Here, when digital signal FSEL is "1", low pass filter 105t is chosen, and when digital signal FSEL is "0", low pass filter 105s is chosen.

[0029] By the above-mentioned configuration, the output-control circuit 105 adjusts the electrical potential difference of DC power supply INP 1 by making analog signal VREF into a command value by the armature-voltage control section VS mentioned above in the 1st, and it operates so that the direct-current constant supply of a predetermined electrical potential difference may be obtained to capacitor 105g both ends. In addition, analog signal VREF is the voltage signal of grand electrical-potential-difference (0V) -5V, and when analog signal VREF is a grand electrical potential difference, the electrical potential difference of capacitor 105g both ends is adjusted by the output-control circuit 105 so that it may be set to 0V. It changes into a RF pulse power source (output between the drain-sources of MOSFET 105k2) with the wave height electrical potential difference of the direct-current constant supply supplied to the capacitor 105g both ends which are the outputs of the armature-voltage control section VS by the RF signal amplifier HA mentioned above in the 2nd in the RF signal FREF (pulse signal (3MHz or 1MHz)). Furthermore, the above-mentioned RF pulse power source is changed into RF AC power supply (output of the both ends of inductance 105o) by the above-mentioned high-pass filter. This high-frequency ac power source lets low pass filter of 3.3MHz of cut off frequencies 105t pass, when digital signal FSEL is "1", and when digital signal FSEL is "0", it lets low pass filter of 1.1MHz of cut off frequencies 105s pass, and it is outputted from an output terminal OUT1 (the other end of an output terminal is a gland).

[0030] In drawing 1 , 106 is a current detector, detects the alternating current i supplied to an ultrasonic vibrator 201 from output terminals OUT1 and OUT2, and changes and outputs the detected current value to the voltage signal IDET with a predetermined conversion ratio (analog signal). Detection of a current is performed by the amplifying circuit which amplifies sensing elements, such as shunt resistance or a hall device, and the output signal of those, and changes with the operational amplifier to the electrical-potential-difference value of a predetermined ratio to change.

[0031] 107 is an electrical-potential-difference detector, detects the alternating voltage v impressed to an ultrasonic vibrator 201 from output terminals OUT1 and OUT2, and changes and outputs the detected electrical-potential-difference value to the voltage signal VDET with a predetermined conversion ratio (analog signal). Detection of an electrical potential difference is performed by the partial pressure circuit which consists of two or more resistors.

[0032] 108 is a power arithmetic circuit and is constituted by each analog operating circuit, such as an average circuit which consists of the multiplication circuit which consists of the analogue integrated circuit for multiplication and

division which accumulated the transistor, the operational amplifier, etc., a resistor, a capacitor, etc., inputs the result of an operation of a multiplication circuit, and calculates the average, and an amplifying circuit which changes the output of an average circuit into a voltage signal with a predetermined conversion ratio. Moreover, analog signal IDET and analog signal VDET are inputted into the multiplication circuit. After changing into a predetermined electrical-potential-difference conversion ratio the result of an operation for which the power arithmetic circuit 108 found the power p which can be found by alternating current i and alternating voltage v to multiplication, and which is supplied to an ultrasonic vibrator 201 by the above-mentioned analog operating circuit, and asked by the above configuration, it outputs as analog signal PCAL.

[0033] 109 is an impedance arithmetic circuit and is constituted by each analog operating circuit which inputs the result of an operation of the division circuit which consists of the analogue integrated circuit for multiplication and division which accumulated the transistor, the operational amplifier, etc., and a division circuit, and calculates an absolute value, such as an absolute-value circuit which consists of diode, a resistor, a capacitor, etc., and an amplifying circuit which changes the output of an absolute-value circuit into a voltage signal with a predetermined conversion ratio. Moreover, analog signal IDET and analog signal VDET which were mentioned above are inputted into the above-mentioned division circuit. After asking for input-impedance z of an ultrasonic vibrator 201 which can ask for the impedance arithmetic circuit 109 by alternating current i and alternating voltage v to the division by the above-mentioned analog operating circuit and changing into a predetermined electrical-potential-difference conversion ratio this result of an operation for which it asked by the above configuration, it outputs as analog signal ZCAL. The ultrasonic electrode 2 contacts suitable for the affected part, and in this example, when the input impedance of an ultrasonic vibrator 201 is normal, when the class of the above-mentioned acoustic wave coupler is gel, the electrical potential difference below 3V is outputted from analog signal ZCAL, and when the class of acoustic wave coupler is ointment, the above-mentioned constant and above-mentioned electrical-potential-difference conversion ratio of each operation part are set up so that the electrical potential difference below 4V may be outputted from analog signal ZCAL.

[0034] 110 is an output-control circuit and outputs analog signal VNML according to the result of having compared with analog signal PCAL analog signal PREF outputted from the output terminal DA 1 of the D-A converter of a controller 102. Moreover, the output-control circuit 110 is constituted by the operational amplifier etc., when analog signal PCAL is smaller than analog signal PREF, analog signal VNML is enlarged, and on the contrary, when analog signal PCAL is larger than analog signal PREF, it operates so that analog signal VNML may be made small. That is, the output-control circuit 110 fluctuates and outputs analog signal VNML so that analog signal PCAL showing the actual input power of an ultrasonic vibrator 201 may be in agreement with analog signal PREF showing the desired value of the input power of an ultrasonic vibrator 201.

[0035] A comparator circuit 111 is constituted by comparator 111a shown in drawing 2 (d). In drawing 2 (d), analog signal ZREF by which analog signal ZCAL was outputted to the negative input terminal of comparator 111a from the output terminal DA 2 of the D-A converter of a controller 102 again is connected to the plus input terminal of comparator 111a. Therefore, digital signal ZCMP which is the output of a comparator circuit 111 is set to "0" when analog signal ZCAL is larger than analog signal ZREF, and on the contrary, when analog signal ZCAL is smaller than analog signal ZREF, it is set to "1." And in this example, when the class of the above-mentioned acoustic wave coupler is gel, on the other hand, analog signal ZREF is set as 3V 4V, when the class of the above-mentioned acoustic wave coupler is ointment. Thereby, irrespective of the class of the above-mentioned acoustic wave coupler, it contacts suitable for the affected part, the ultrasonic electrode 2 is set to "1" when the input impedance of an ultrasonic vibrator 201 is normal (namely, when the reflection factor in the radial plane of the above-mentioned supersonic wave is low), and digital signal ZCMP is set to "0", when the impedance of an ultrasonic vibrator 201 is unusual (namely, when the reflection factor in the radial plane of the above-mentioned supersonic wave is high).

[0036] The change-over circuit 114 is constituted by analog switches 114a and 114b and inverter 114c as it is shown in drawing 2 (e). And when digital signal VSEL is "1", analog signal VNML is outputted as analog signal VLVL, and when digital signal VSEL is "0", analog signal VLOW is outputted as analog signal VLVL. In addition, analog signal VLOW is a voltage signal determined by the division ratio of resistor 112a and resistor 112b, and in case it reduces the input power of an ultrasonic vibrator 201, it is a signal used as analog signal VREF which is the command value of the output-control circuit 105.

[0037] According to the configuration of the output mode setting circuit 104 and the change-over circuit 114, analog signal VREF which is the command value of the output-control circuit 105 is created as follows by digital signal SGLM and VSEL. First, when digital signal SGLM is "0", analog signal VREF serves as a grand electrical potential difference (0V) irrespective of digital signal VSEL. On the other hand, when digital signal SGLM is "1", when digital signal VSEL is "1", analog signal VNML is set to analog signal VREF according to digital signal VSEL, and when

digital signal SGLM is "0", analog signal VLOW is set to analog signal VREF.
[0038] 113 is a resistor and constitutes the potentiometer which pressures 5V power source partially by resistance ratio with a resistor 202. The partial pressure electrical potential difference of this resistor 113 and a resistor 202 is inputted into the input terminal AD 1 of the A-D converter of a controller 102. In this example, the resistance of a resistor 202 prepared in the ultrasonic electrode 2 which consists of the ultrasonic vibrator 201 4.3k ohms and whose resonance frequency are 1MHz is set as 23k ohms for the resistance of a resistor 202 prepared in the ultrasonic electrode 2 which sets a resistor 113 as 10k ohms, and consists of the ultrasonic vibrator 201 whose resonance frequency is 3MHz. When the ultrasonic electrode 2 for about 3.5V and frequency 1MHz in the electrical-potential-difference value inputted into the terminal AD 1 of a controller 102 by this when the ultrasonic electrode 2 for frequency 3MHz is connected to the body 1 of an ultrasonic therapy apparatus is connected to the body 1 of an ultrasonic therapy apparatus, the electrical-potential-difference value inputted into the terminal AD 1 of a controller 102 is set to about 1.5 V. Moreover, since a resistor 202 cannot constitute a potentiometer with a resistor 113 when the ultrasonic electrode 2 is not normally connected to the body 1 of an ultrasonic therapy apparatus, a grand electrical potential difference (0V) is inputted into the terminal AD 1 of a controller 102.
[0039] As shown in drawing 1 , resistors 118, 119, and 120 and switches 121, 122, and 123 are connected to the digital input terminals P5, P6, and P7 of a controller 102, respectively. The switching condition of these switches 121, 122, and 123 is inputted into a controller 102 as a digital signal as follows. A switch 121 is set as gel, when it is the switch which sets up the class of the above-mentioned acoustic wave coupler, the class of acoustic wave coupler is set as ointment when the switch 121 has closed ("0" is inputted into a terminal P5), and the switch 121 is open ("1" is inputted into a terminal P5).
[0040] The approach a switch 122 emits the radiation approach of the above-mentioned supersonic wave continuously Or when it is a switch for setting up which [of the approach (a pulse mode is called below) of emitting intermittently] it is made and the switch 122 has closed, (Continuous mode is called hereafter) It is set up by continuous mode when ("0" being inputted into a terminal P6) and a switch 122 are open to the pulse mode ("1" is inputted into a terminal P6).
[0041] How (normal mode is called below) to set the radiation approach of the supersonic wave of the above-mentioned [a switch 123] as one one of the modes of continuous mode or a pulse mode, Or it is a switch for setting up which [that emits a supersonic wave while switching continuous mode and a pulse mode by turns according to therapy time amount / of an approach (a program mode is called below)] it is made. the time of the switch 123 having closed -- a program mode -- (-- "0" inputs into a terminal P7 -- having --) -- moreover, when the switch 123 is open, it is set as normal mode ("1" is inputted into a terminal P7).
[0042] 124 is a resistor and is really [switch] which consists of variable-resistor 125a and switch 125b connected to the formal variable resistor 125 and the digital input terminal P8 of a controller 102. The sliding terminal of variable-resistor 125a is connected to the input terminal AD 2 of the A-D converter of a controller 102. This switch 125b is an actuation switch used in case an operator turns on or turns off the output (that is, power inputted into an ultrasonic vibrator 201 from output terminals OUT1 and OUT2) of the body 1 of an ultrasonic therapy apparatus. When the output of the body 1 of an ultrasonic therapy apparatus is set as ON by the controller 102 when actuation switch 125b has closed ("0" inputted into a terminal P8), and the switch is open ("1" inputted into a terminal P8), an output is set up off. Variable-resistor 125a is used in order that an operator may set up the desired value of the input power of the above-mentioned ultrasonic vibrator 201. When the division ratio of variable-resistor 125a is min, electrical-potential-difference value 0V are inputted into an input terminal AD 2, and the desired value (analog signal PREF) of the input power of an ultrasonic vibrator 201 is set as the minimum value by the controller 102. On the other hand, when the division ratio of variable-resistor 125a is max, electrical-potential-difference value 5V are inputted into a terminal AD 2, and the desired value (analog signal PREF) of the input power of an ultrasonic vibrator 201 is set as maximum by the controller 102.
[0043] 126 is a buzzer and is constituted by the piezoelectric device. 127 and 128 are resistors and are respectively connected to light emitting diodes 129 and 130. A buzzer 126 and light emitting diodes 129 and 130 are connected to the output terminal of inverters 131, 132, and 133, respectively. The input terminal of inverters 131, 132, and 133 is connected to the digital output terminals P9, P10, and P11 of a controller 102, respectively. By this, when the digital output terminal P9 is "1", a buzzer turns on, and when it is "0", a buzzer turns off. Moreover, the light emitting diode 129 which displays the supply condition of the input power of the above-mentioned ultrasonic vibrator 201 when the digital output terminal P10 is "1" lights up, and the light is put out when it is "0." Moreover, when the digital output terminal P11 is "1", the light emitting diode 130 which displays the class of the above-mentioned ultrasonic electrode 2 lights up, and the light is put out when it is "0." In addition, in this example, when it indicates that the input power of the above-mentioned ultrasonic vibrator 201 is normally supplied when light emitting diode 129 lights up and light

emitting diode 130 lights up, it indicates that the frequency of the above-mentioned ultrasonic vibrator 201 is 3MHz.
[0044] Below, actuation of the above-mentioned controller 102 is explained with reference to the flow chart shown in drawing 3 and drawing 4 . Drawing 3 is a flow chart showing the outline of the main program of the above-mentioned controller 102, and drawing 4 is a flow chart showing the outline of three kinds of subprograms called from the main program shown in drawing 3 . 5V power source is supplied to a controller 102 from a power circuit 101, and further, the main program shown in drawing 3 is started, after a reset signal is inputted. First, in step S1, initial setting, such as a setup of the A-D converter of the controller 102 interior, a setup of a D-A converter, a setup of the I/O direction of a digital-input/output terminal, and a setup of a timer circuit, is performed. Furthermore in step S1, the output of a D-A converter and the output of a digital output terminal are initialized by 0V and "0", respectively.
[0045] Next, if it progresses to step S2, reading of the condition of actuation switch 125b will be performed. At step S2, when actuation switch 125b changes into the condition (namely, digital input terminal P8="0") of ON, a setup which enables actuation switch interruption processing with initial setting of the actuation switch interruption processing generated when actuation switch 125b next turns off is performed. In addition, in actuation switch interruption processing, when actuation switch 125b turns off, processing jumped to step S1 is performed. Processing which turns off the output of an ultrasonic therapy apparatus irrespective of the operating state of the timer 1 later mentioned by actuation switch interruption processing by this when an operator turns off actuation switch 125b, and a timer 2 ("0" is outputted from the digital output terminal P2.) That is, digital signal SGLM is set as "0". It is carried out.
[0046] Next, at step S3, the electrical potential difference of an input terminal AD 1 is read, and the class (frequency) of ultrasonic electrode 2 is judged with the value. And according to the frequency of the judged ultrasonic vibrator 201, digital signal VSEL is set up as follows. When the frequency of an ultrasonic vibrator 201 is 3MHz, digital signal VSEL is set as "1" (namely, when an input terminal AD 1 is about 3.5V (3V-4V)). On the other hand, when the frequency of an ultrasonic vibrator 201 is 1MHz, digital signal VSEL is set as "0" (namely, when an input terminal AD 1 is about 1.5V (1V-2V)). And only when the frequency of an ultrasonic vibrator 201 is 3MHz, processing which outputs "1" from the digital output terminal P11, and turns on light emitting diode 130 is performed. Moreover, in step S3, when the electrical potential difference of an input terminal AD 1 is less than [1V], after the above-mentioned ultrasonic electrode 2 judges that it is in the condition which is not normally connected to the body 1 of an ultrasonic therapy apparatus, outputs "1" from the digital output terminal P9 and turns on a buzzer 126, a main program is ended. In addition, when a main program is completed in a controller 102, the reboot of a main program is performed by the actuation switch interruption processing generated when a reset signal is inputted into a controller 102 or actuation switch 125b turns off.
[0047] Next, if it progresses to step S4, the condition of a switch 121 (input signal of the digital input terminal P5) will be read, and the class of the above-mentioned acoustic wave coupler will be judged with the value. And according to the class of judged acoustic wave coupler, it is carried out as a setup of the output voltage of an output terminal DA 2 is the following. That is, since a setup of the class of acoustic wave coupler is ointment when the switch 121 turns on, a setup which outputs 4V from an output terminal DA 2 is performed. On the other hand, since a setup of the class of acoustic wave coupler is gel when the switch 121 turns off, a setup which outputs 3V from an output terminal DA 2 is performed.
[0048] Next, if it progresses to step S5, normal mode or a program mode will be judged for the radiation approach of a supersonic wave based on the condition of a switch 123 (DETARU input terminal P7). And when a setup of the radiation approach is normal mode, it progresses to step S6 (when it is digital input terminal P7="1").
[0049] At step S6, it is set as the timer 1 which is one of the timer circuits in which all the therapy time amount (therapy end time) in one therapy of the ultrasonic therapy apparatus mentioned above was contained by the controller 102, and actuation of a timer 1 is started. In addition, the timer circuit ended actuation, when it went through the time amount set up from initiation of operation, and it is equipped with the circuit which carries out storage maintenance of the termination of operation further. A timer 1 is set up in 15 minutes and made to start actuation at step S6 here.
[0050] Next, if it progresses to step S7, continuous mode or a pulse mode will be judged for the radiation approach of a supersonic wave based on the condition of a switch 122 (digital input terminal P6). And when a setup of the radiation approach is continuous mode, it progresses to a continuous mode subprogram at step S8 (when it is digital input terminal P6="1"). In addition, about this continuous mode subprogram, it mentions later. And after this continuous mode subprogram is completed, it progresses to step S11 next.
[0051] At step S11, while setting the digital output terminals P2, P9, P10, and P11 to "0" and turning off radiation of a supersonic wave, light emitting diodes 129 and 130 are switched off, and a buzzer 126 is turned off. And a main program is ended.
[0052] On the other hand, at step S7 mentioned above, when a setup of the radiation approach is a pulse mode, it

progresses to a pulse mode subprogram by step S9 (when it is digital input terminal P6="0"). And after a pulse mode subprogram is completed, it progresses to step S11 mentioned above.
[0053] On the other hand, in step S5 mentioned above, when the radiation approach is a setup of a program mode, it progresses to a program mode subprogram at step S10 (when it is digital input terminal P7="0"). And after a program mode subprogram is completed, it progresses to step S11 mentioned above.
[0054] next, the flow of the program of a continuous mode subprogram, a pulse mode subprogram, and a program mode subprogram -- respectively -- the drawing 4 (**) and (**) -- and (Ha) it refers to and explains. Drawing 4 (b) is the flow chart of a continuous mode subprogram. In this continuous mode subprogram, it is a step SA 1 first and the judgment of whether actuation of a timer 1 is completed is performed. And when actuation of a timer 1 is completed, it returns from a continuous mode subprogram to the program which called this program. In the judgment of the another side step SA 1, when actuation of a timer 1 is not completed, it progresses to a step SA 2. At a step SA 2, processing of item (1) - (3) shown below is performed. In a step SA 2, after the following processings are completed, it returns to a step SA 1.
[0055] (1) Output as analog signal PREF from an output terminal DA 1 after reading the desired value of the input power of an ultrasonic vibrator 201 set up by variable-resistance 125a at any time (namely, the electrical-potential-difference value of an input terminal AD 2 reading) and performing predetermined conversion and amendment. Moreover, digital signal SGLM and digital signal VSEL (digital output terminals P2 and P3) are set as "1." Thereby, except the condition decided by degree item (2), the input command value VREF of the output-control circuit 105 is determined according to a setup and analog signal PCAL of analog signal PREF (namely, variable-resistance 125a). Moreover, the idle state of a timer 1 of operation is canceled.
[0056] (2) While setting the command value of the output-control circuit 105 as min when the supersonic wave is emitted, and the condition which is not normal continues more than for 0.5 seconds, suspend actuation of a timer 1. That is, a setup of a digital SGLM signal is "1" (digital output terminal P2="1"). And once the condition that digital signal ZCMP (digital input terminal P4) is "0" is materialized, When [which the condition that digital signal SGLM was "1" and digital signal ZCMP was "1" continued more than for 0.5 seconds] not materialized, while setting digital signal VSEL (digital output terminal P3) to "0", actuation of a timer 1 is suspended. Moreover, when the condition that digital signal SGLM is "1" and digital signal ZCMP is "1" is materialized, digital signal VSEL is set to "1."
[0057] (3) When digital signal VSEL is "1", processing ("0" is outputted from a digital output P9) which turns on the light emitting diode 129 which displays the supply condition of the input power of an ultrasonic vibrator 201 ("1" is outputted from a digital output P10), and turns off a buzzer 126 is performed. On the other hand, when digital signal VSEL is "0", processing ("1" is outputted from a digital output P9) which switches off a light emitting diode 129 ("0" is outputted from a digital output P10), and turns on a buzzer 126 is performed.
[0058] Next, the flow of the program of a pulse mode subprogram is explained with reference to drawing 4 (b). At the step SB 1 of a pulse mode subprogram, the judgment of whether actuation of a timer 1 is completed is performed like the step SA 1 of a continuous mode subprogram. And when actuation of a timer 1 is completed, it returns from a pulse mode subprogram to the program which called this program. In the judgment of the another side step SB 1, when actuation of a timer 1 is not completed, it progresses to a step SB 2. Next, at a step SB 2, processing (2) in processing (1)' shown below and the step SA 2 mentioned above and the same processing as (3) are performed. And it returns to a step SB 1.
[0059] Hereafter, processing of item (1)' in a step SB 2 is explained.
(1) After reading the desired value of the input power of an ultrasonic vibrator 201 set up by 'variable-resistance 125a at any time (namely, the input voltage value of an input terminal AD 2 reading) and performing predetermined conversion and amendment, it outputs as analog signal PREF from an output terminal DA 1. Furthermore, from digital signal SGLM (namely, digital output terminal P2), "1" and "0" are repeated intermittently, and are outputted. Here, after "0" is outputted between 8ms of time amount, the intermittent output signal with which "1" is outputted between 2ms of time amount is repeatedly outputted as digital signal SGLM. Moreover, digital signal VSEL (namely, digital output terminal P3) is set as "1." Thereby, except the condition decided by processing (2) of a step SA 2, the input command value of the output-control circuit 105 is determined according to a setup of analog signal PREF (namely, variable-resistance 125a). And a timer 1 is set as operating state.
[0060] Next, the flow of the program of a program mode subprogram mentioned above is explained with reference to drawing 4 (Ha). In a program mode subprogram, a setup of a timer 1 and the timer 2 which is the same timer circuit is first performed at a step SC 1. A timer 2 is set up in 15 minutes and actuation is made to start it at a step SC 1. Next, at a step SC 2, it judges whether actuation of a timer 2 is completed. When actuation of a timer 2 is completed in a step SC 2, it returns from a program mode subprogram to the program which called this program.

[0061] On the other hand, in the judgment of a step SC 2, when actuation of a timer 2 is not completed, it progresses to a step SC 3. At a step SC 3, processing of a timer 1 is performed like step S6. However, at a step SC 3, a timer 1 is set up in 1 minute. Next, if it progresses to a step SC 4, it will progress to the continuous mode subprogram mentioned above. After a continuous mode subprogram is completed, it progresses to a step SC 5. At a step SC 5, processing of a timer 1 is performed like a step SC 3. At a step SC 5, a timer 1 is set up in 1 minute like a step SC 3. Next, it progresses to a pulse mode subprogram at a step SC 6. After a pulse mode subprogram is completed, it returns to a step SC 2.
[0062] Next, actuation of the ultrasonic therapy apparatus by the above-mentioned configuration is explained according to a condition.
(b) If actuation switch 125b is turned on after an operator connects the ultrasonic electrode 2 with a frequency of 3MHz to the body 1 of an ultrasonic therapy apparatus, and turn on the electric power switch of a power circuit 101, turning ON a switch 121, setting the class of acoustic wave coupler as ointment, turning OFF a switch 122 and a switch 123 and setting up the radiation approach of the supersonic wave of continuous mode beforehand, a supersonic wave with a frequency of 3MHz will be emitted from the ultrasonic electrode 2. Here, an ultrasonic therapy apparatus turns on light emitting diode 129, and it indicates that the supersonic wave is emitted normally, and light emitting diode 130 is turned on and it indicates that the frequency of a supersonic wave is 3MHz. The supply voltage to the ultrasonic electrode 2, i.e., the radiation output of a supersonic wave, is adjusted when an operator operates resistor 125a. If contact on the ultrasonic electrode 2 and the body comes out enough, and the therapy elapsed time after actuation switch 125b is turned on passes for 15 minutes in a certain case or switch 125b is turned off, radiation of a supersonic wave will turn off and light emitting diodes 129 and 130 will be switched off. After the above actuation is completed, an ultrasonic therapy apparatus suspends actuation. A reboot is performed by turning on again, once it turns off actuation switch 125b or an electric power switch.
[0063] (b) In the above-mentioned (b) of operation, when the ultrasonic electrode 2 with a frequency of 1MHz is connected to the body 1 of an ultrasonic therapy apparatus, a supersonic wave with a frequency of 1MHz is emitted from the ultrasonic electrode 2, and switch off light emitting diode 129.
[0064] (c) In the above-mentioned (b) of operation, when the condition which is not enough continues more than for 0.5 seconds, an ultrasonic output decreases. Moreover, a buzzer 126 turns on in coincidence and light emitting diode 129 puts out the light to it. Then, if the ultrasonic electrode 2, the body, and contact will be in sufficient condition, the radiation output of a supersonic wave will turn into an output adjusted like the above-mentioned (b) of operation when resistor 125a is again operated by the operator. Moreover, a buzzer 126 is turned off and turns on light emitting diode 129. Moreover, when the condition which is not enough continues more than for 0.5 seconds, the radiation output of a supersonic wave decreases. In addition, the time amount to which the radiation output of a supersonic wave is decreasing is not included in the above-mentioned therapy elapsed time for 15 minutes.
[0065] (d) In the above-mentioned (b) of operation, when a switch 122 is turned on beforehand and the acoustic emission approach of a pulse mode is set up, after radiation of a supersonic wave turns off for 8ms, a supersonic wave is repeatedly emitted by the intermittent radiation approach of 10ms of periods turned on for 2ms.
[0066] (e) On the other hand, when a switch 123 is turned on beforehand and the radiation approach of a program mode is set up in the above-mentioned (b) of operation, a supersonic wave winds radiation by the continuous mode for 1 minute, and radiation by the pulse mode for 1 minute by turns with the period for 2 minutes, and is emitted by the ****** approach.
[0067] In addition, in the above-mentioned example, although a setup of the frequency of the ultrasonic electrode 2 is prepared in the ultrasonic electrode 2 and performed using the **** resistor 202, a switch 121 and the same switch are formed and an operator can set up the frequency of a supersonic wave.
[0068] Moreover, although considered as the oscillator circuit which an oscillator circuit 103 switches the two-kind frequency of 3MHz or 1MHz set up beforehand, and can be oscillated in the above-mentioned example In order to amend dispersion in the resonance frequency by the solid-state difference of an ultrasonic vibrator 202 For example, it is good also as an oscillator circuit which enabled it to tune an oscillation frequency finely combining the frequency divider which can carry out adjustable [of the division ratio], and the phase DOROKKU loop-formation oscillator which can switch a basic oscillation frequency to 3MHz and 1MHz by the controller 102.
[0069] Furthermore, in the above-mentioned example, although even free [of the approach of switching by turns the pulse mode to which intermittence time amount was beforehand determined as continuous mode by fixed time amount] is decided beforehand, the radiation approach of the supersonic wave in a program mode is the following, makes the radiation approach in a program mode, and can also be set up. The method of setting up ON and the off rate of the duration of continuous mode, the set point of the magnitude of the ultrasonic output in continuous mode, the duration of a pulse mode and an interruption period, and one interruption period, the set point of the magnitude of the

ultrasonic output in a pulse mode, and two or more pulse modes for combination etc. is possible by preparing the key switch group which combined the function key and the ten key as the setting approach of the radiation approach of the supersonic wave in a program mode. Moreover, it is also possible to be the following, to make the output method set up by making it such, and to memorize. Moreover, how to memorize the set point for every symptom of every patient and a disease, using an IC card, a magnetic card, etc. as a store method of a setup of these program modes can be considered.

[0070] In addition, in the above-mentioned example, although only the frequency of the ultrasonic electrode 2 is distinguished using a resistor 202, discernment of the magnitude of a different radial plane etc. can also be similarly performed using a resistor 202.

[0071] Moreover, although the end time of ultrasonic therapy is beforehand set up in 15 minutes, an operator establishes and does adjustable [of the input means which can be set as arbitration], and may enable it to set it up in this example.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the configuration of the ultrasonic therapy apparatus by one example of this invention.
[Drawing 2] It is drawing showing the detail of main blocks given in drawing 1 .
[Drawing 3] It is the flow chart of the main program of the controller 102 given in drawing 1 .
[Drawing 4] It is the flow chart of the subprogram of the controller 102 given in drawing 1 , and (**) is [a pulse mode subprogram and (Ha of a continuous mode subprogram and (**))] the flow charts of a program mode subprogram.
[Description of Notations]
1 .... the body of an ultrasonic therapy apparatus, and 2 .. the ultrasonic electrode and 102 .. a controller and 103 .. an oscillator circuit and 104 .. an output mode setting circuit and 105 .. an output-control circuit and 106 .. a current detector and 107 .. an electrical-potential-difference detector and 109 -- .. -- an impedance arithmetic circuit and 111 -- .. -- a comparator circuit and 114 -- .. -- a change-over circuit and 121 -- .. -- a switch and 113 -- .. -- a resistor and 202 -- .. -- a resistor and 103b -- .. -- an analog switch and 105s .. a low pass filter and 105t -- .. -- a low pass filter and 105r1 -- .. -- a relay and 105r2 -- .. -- a relay

[Translation done.]

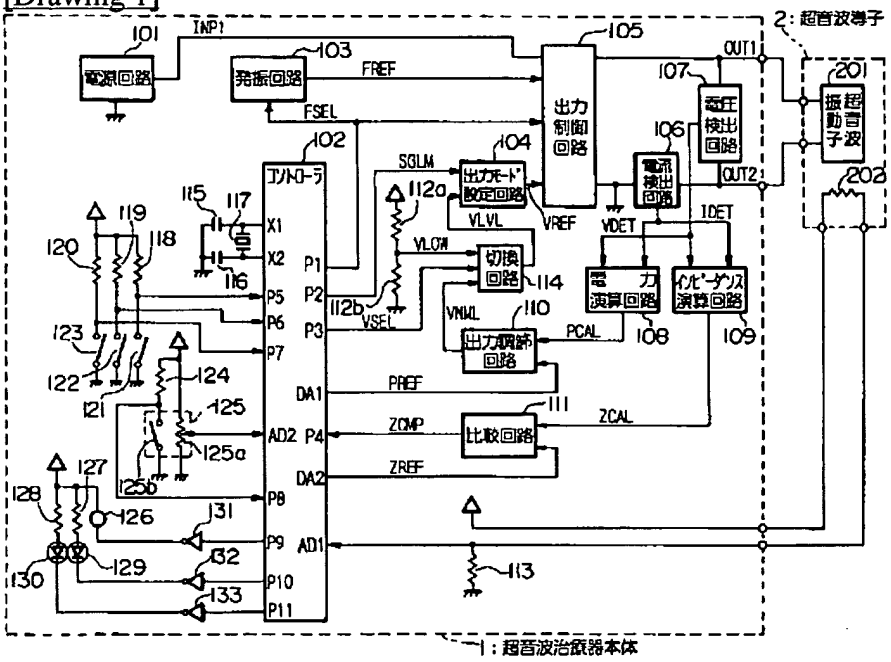
* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

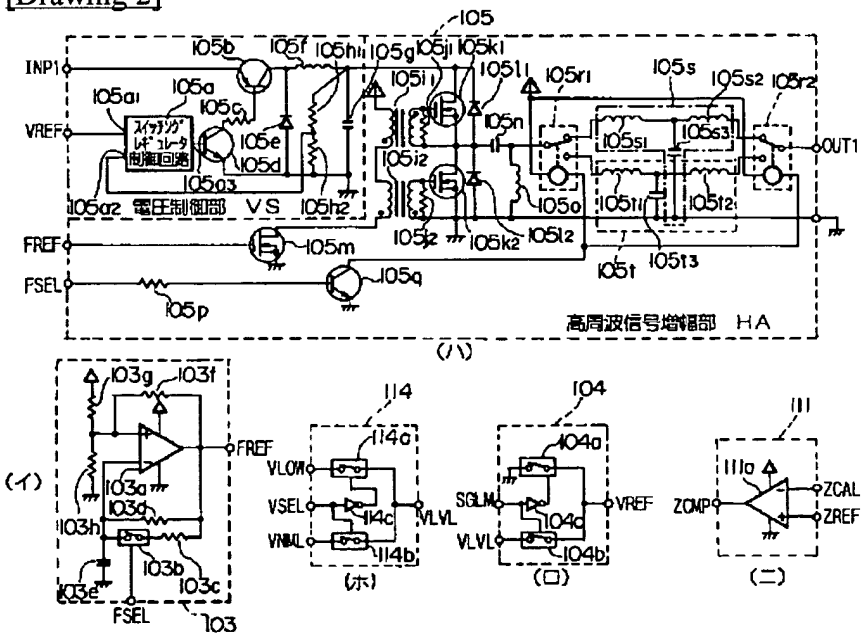
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

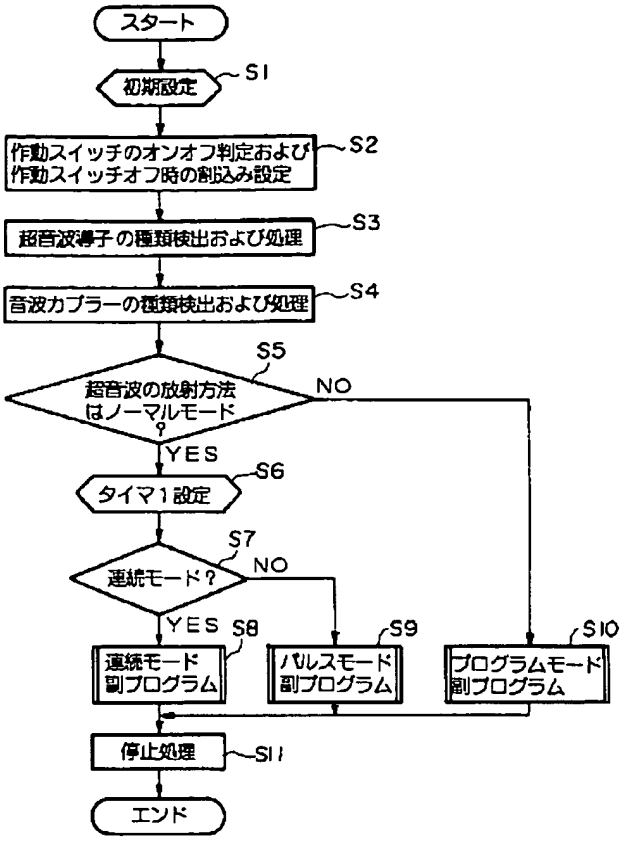
[Drawing 1]



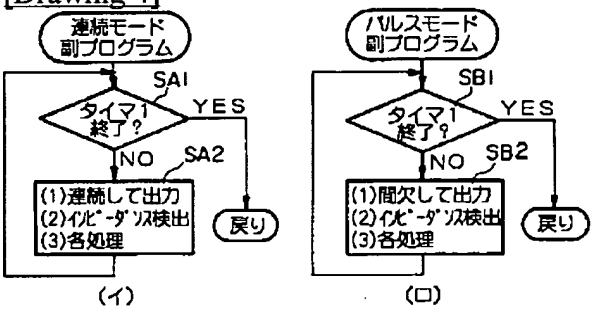
[Drawing 2]

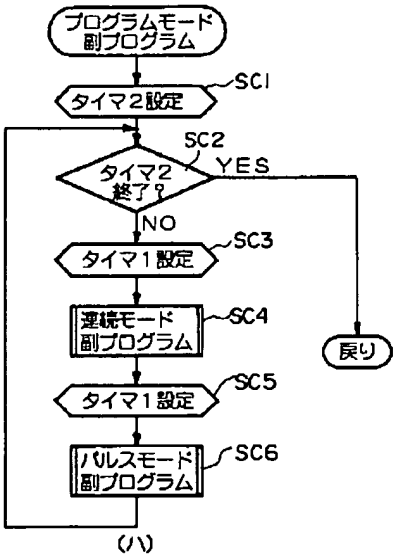


[Drawing 3]



[Drawing 4]





[Translation done.]